Solar Mass Ejection Imager (SMEI) Mission: Final Report

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#### 1. EXECUTIVE SUMMARY

The Solar Mass Ejection Imager experiment, launched 6 January 2003 on Coriolis, continues to detect and track Coronal Mass Ejections (CMEs). A proof-of-concept experiment, SMEI has outlived its planned 2-3 year lifetime and amassed a database of full-sky images with a 102 minute cadence recorded for almost five years.

After its first year of operation, control of Coriolis was transferred from the Air Force Space Test Program to the Navy, who operates the spacecraft today and provides SMEI data to AFRL, as well as executing routine operations, such as calibrations, mask uploads, resets, etc. at no charge to the Air Force Research Laboratory. The Navy plans to operate Coriolis for as long as its experiment, Windsat, is functional.

Because of an irrecoverable failure on its A-side redundant electronics (March 2006), SMEI has been switched to B-side, which is operating nominally. Camera 3 (closest to the Sun) has run above predicted/planned for temperatures and performance continually degrades with accumulated radiation dose. In addition to periodic anneals to help alleviate this problem, we have instituted a severe on-board masking of hot pixels in Camera 3 since 2006.

Despite these problems, SMEI has amassed a wealth of detailed images of coronal mass ejections (CMEs), as well as other phenomena, such as high altitudes auroras, variable stars, zodiacal dust, Gegenschein, and comet tail interactions with the heliosphere. SMEI has demonstrated that such an instrument can accomplish a 30% and greater improvement in space weather forecasts.

At the time of this report, the SMEI team is working with the Air Force Space Weather Agency to incorporate SMEI data into their operational forecasts. A workshop on future heliospheric imaging missions to meet DoD needs was held in April 2007 at the Air Force facilities at the National Solar Observatory at Sunspot, NM, at which the Air Force and Navy agreed to work together to field the next heliospheric imager.

## 2. PERFORMANCE

## 2.1 Hardware

A complete description of the SMEI hardware can be found in [Eyles et al. 2003]. The Coriolis satellite is in a dawn-dusk, Sun-synchronous, circular polar orbit at an altitude of 840 km. The inclination of the orbit is 98° relative to the equatorial plane. The sensor suite consists of three carefully baffled CCD cameras, each covering a narrow 3° × 60° strip of the sky. The cameras are mounted on the satellite with their fields of view aligned end-to-end and slightly overlapping, so that the field of view swath is a 3° wide strip extending 160°, an approximate great circle with the ends near the orbit axis. Since the satellite is zenith-nadir pointing, during each complete orbit the cameras' fields of view sweep out nearly 90% of the entire sky. Gaps include a zone of exclusion of 20° radius in the direction of the Sun, a smaller circle in the anti-solar direction, and shuttered areas due to sunlight in the sunward camera. The instrument operates continuously, so the data set comprises a sequence of orbit images, 14 per day. It has maintained about an 85% duty cycle interrupted only for periodic calibration and diagnostic purposes, and occasionally for software anomalies and telemetry problems. The unfiltered CCDs have a red-biased spectral response from ~ 500 to 1100 nm peaking at 700 nm.

#### 2.1.1. SMEI DESIGN PHILOSOPHY

SMEI was conceived and developed as a relatively low cost, 'proof-of-concept' instrument with a 2-year design lifetime (original requirement) and the aim of continuation through a third year. It has completed almost five years of operation. SMEI designers baselined use of hi-rel mil-spec parts rather than full space-quality, that is, integrated circuits to MIL-STD-883 Level B; MIL-38535 where possible, and used discrete semiconductors to JANTX; JANTXV where possible. The design used parts of known radiation tolerance rather than rad-hard to meet a 10 krad total dose spec at the component level. Parts with known radiation tolerance were used where possible, with total dose testing performed on parts of unknown radiation tolerance using a Co60 source.

Local shielding for parts of low radiation tolerance, *e.g.* the DHU Processor was used, along with parts of good "single-event" tolerance (SEU and SEL) where known. There was no formal SEU/SEL tolerance requirement or testing. Examples of measures taken to enhance and ensure reliability given 'compromises' on parts quality, etc. included:

- Two fully-redundant Data Handling Units (DHUs) 'B' system in coldredundancy.
- Redundant spacecraft interfaces: DHU-A power from spacecraft PDU-A; DHU-B from PDU-B, and each DHU has interfaces to spacecraft MIL-STD-1553B Bus A and Bus B. Also, a provision of an internally-generated 1Hz sync pulse if the spacecraft 1Hz is lost.
- Careful design for protection against latch-ups (SELs) Current limiting at component, group of components or PCB level, by active current trips and/or limiting resistors as appropriate.

- Each Camera is 'single string', but careful attention paid to fault-tolerance of interfaces with DHUs. There is an independent power converter system in each camera and propagation of failures between cameras is not allowed.
- Eight redundant copies of on-board software in write-protected E2PROM selected in a robust manner by re-asserting 'DHU On' relay command.
- Capability of patching on-board software using write-enabled E2PROM as a provision for recovery from a 'bad' uplinked patch.

#### 2.1.2 OVERALL PERFORMANCE FIRST THREE YEARS

There were no hardware failures until 31 March 2006. Until then, the DHU B had never been switched on. There is no evidence of bit-errors in copies of on-board software in E2PROM, SEL events in DHU, and no significant changes in voltage and current Analog Monitors (table below).

Table 1. DHU Voltage and Current, 2003 and 2006

	Feb 2003	Feb 2006
Processor PCB 5V	$4.94 \pm 0.05 \text{ V}$	$4.94 \pm 0.05 \text{ V}$
Processor PCB Current	Quiescent 0.32 ± 0.05 A Peaks to 0.9 A	Quiescent 0.32 ± 0.05 A Peaks to 0.9 A
Instrument Current (excluding De-Icer Heaters)	$0.72 \pm 0.05 \text{ A}$	$0.72 \pm 0.05 \text{ A}$

DHU temperatures have increased (table below). Camera 1 and 2 CCD temperatures are within optimal operating range; Camera 3 is running hot.

Table 2. Electronics Temperatures, 2003 and 2006

	Feb 2003	Feb 2006
Processor PCB Temperature	21.5 ± 1.0 C	25.2 ± 0.8 C
DHU Power Supply Temperature	18.6 ± 1.0 C	21.0 ± 0.6 C

## 2.1.2.1 DHU Processor Performance

- Data throughput from cameras required a fast processor (11.71 μs per pixel for each of 3 cameras).
- Selected processor was Texas Instruments SMJ320C50 DSP
  - 20 MIPS performance (with 20Mhz clock actually de-rated to 19Mhz)
  - Available to MIL-STD-883 Level B, but not rad-hard
  - Limited total dose data, no SEU/SEL data
  - Total dose tested in-house, 4 5 krad tolerance

- Local shielding to improve TID tolerance, current limiter for SEL protection
- Attempted to provide protection against crashes using watch-dog timer
- DHU upsets and anomalies have occurred fairly frequently
  - Usually require DHU reset, only occasionally fixed by going back to Configuration Mode
  - Have never required powering off DHU, so no SEL events in DHU
  - Cannot exclude possibility of some SEL events in cameras since cameras are power-cycled on DHU reset, but unlikely
  - The CODE\_VER telemetry parameter increments on DHU reset, provides count of resets.

The average rate of resets is  $\sim 1$  per 2 weeks, with no evidence of a significant increase in rate after the first 6 months.

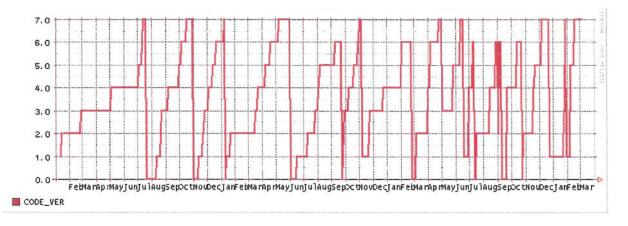


Figure 1. Data Handling Unit Resets Required during First Three Years

Table 3. DHU Re-Boots Required, by Quarter, 2003 to 2006

	Number of Re-Boots		Number of Re-Boots
1-Feb-03 to 30-Apr-03	2	1-Aug-04 to 31-Oct-04	11
1-May-03 to 31-July-03	3	1-Nov-04 to 31-Jan-05	4
1-Aug-03 to 31-Oct-03	5	1-Feb-05 to 30-Apr-05	4
1-Nov-03 to 31-Jan-04	7	1-May-05 to 31-July-05	8
1-Feb-04 to 30-Apr-04	9	1-Aug-05 to 31-Oct-05	9
1-May-04 to 31-July-04	4	1-Nov-05 to 31-Jan-06	5

## 2.1.2.2 Thermal Hardware

Over the course of the first three years, DHU temperatures have increased by  $\sim 2-3$  °C. The best indicator of the overall camera temperature is the mirror temperature. There has been no evidence of a significant upward trend in Camera 1 or 2. Camera 3 temperatures have increased by  $\sim 3$  °C.

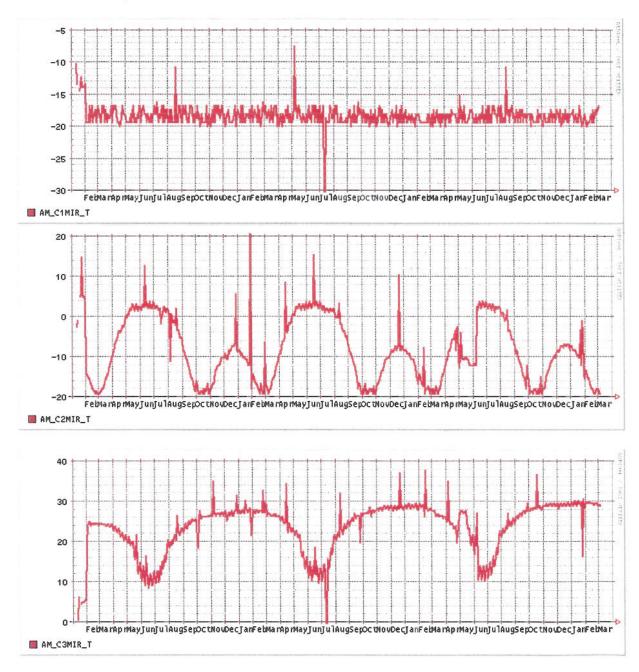


Figure 2. Temperatures of the Camera Mirrors, for (top to bottom) Cameras 1, 2, and 3.

CCD Temperatures experienced  $\sim 1-2^{\circ}\text{C}$  increase over 3 years in Camera 3; less in Cameras 1 and 2.

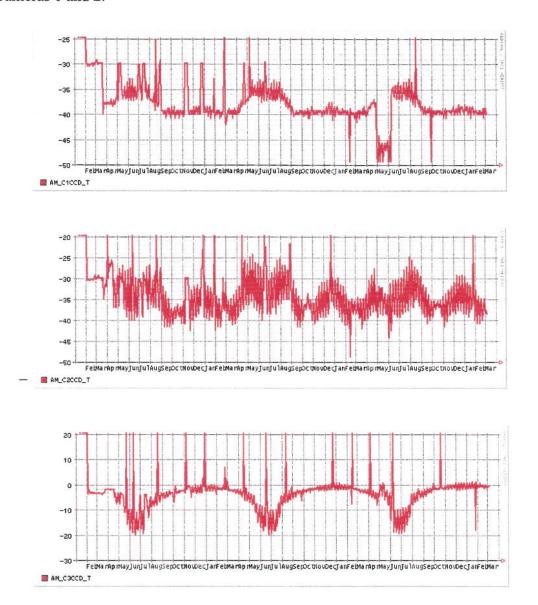


Figure 3. CCD Temperatures for (top to bottom) Cameras 1, 2, and 3.

CCD dark charge is measured in closed shutter calibrations, using the mode of pixel readout value (rather than the mean) to avoid biasing by hot pixels. Camera 1 shows progressive increase due to radiation damage from  $\sim 1$  ADU to  $\sim 6$  ADU, reduced by periodic annealing at  $\sim 45-50$ °C.

# Camera 1 Dark Charge Evolution

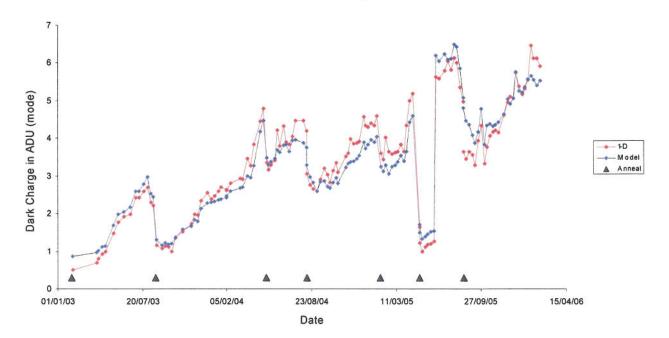


Figure 4. Camera 1 Dark Charge Evolution

The model is fit to  $I_{dark} = (a_0 + a_1t + a_2\delta t) \exp{(-a_3T)}$ , where t is time since launch,  $\delta t$  is time since last anneal and T is temperature (K).

Camera 2 shows progressive increase from  $\sim$  2 ADU to  $\sim$  8 ADU, reduced by periodic annealing at  $\sim$  50°C.

# Camera 2 Dark Charge Evolution

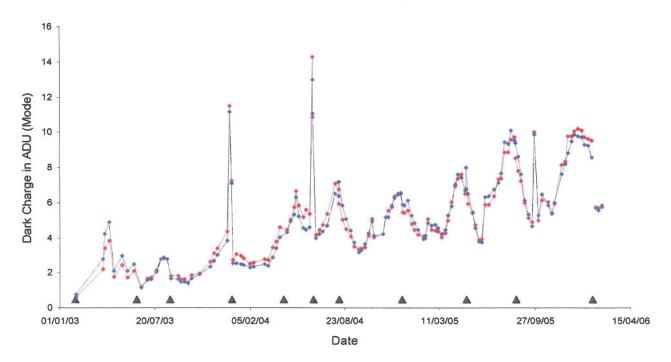


Figure 5. Camera 2 Dark Charge Evolution

Frequent annealing at ~ 80°C is not very effective.

# Camera 3 Dark Charge Evolution

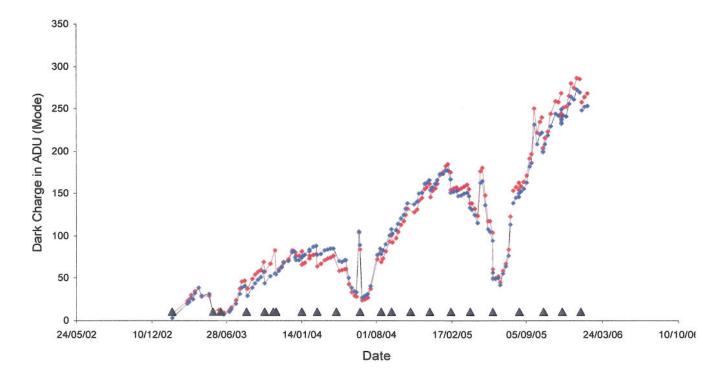


Figure 6. Camera 3 Dark Charge Evolution

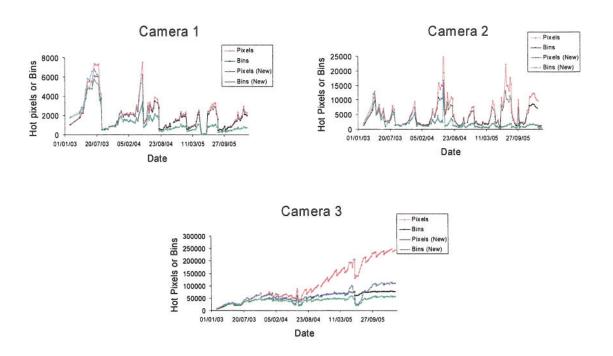


Figure 7. Evolution of the Number of Hot Pixels for Each Camera

Although Camera 1 and 2 CCD temperatures are quite acceptable, -40 to -50°C would be better. The SMEI thermal model incorrectly predicted temperatures which led the team to mask off portions of the radiators on Cameras 1 and 2 so that epoxies would not become brittle. It was also considered for Camera 3's radiator, which if implemented, would have been disastrous on the Camera 3 performance. Masking Camera 1 and 2 radiators was unnecessary. Camera 3 CCD temperature is a continuing and worsening problem. It has been mitigated by periodic annealing and hot pixel masking, but the camera will continue to degenerate from radiation damage. Cameras 1 and 2 experience the same radiation dose as Camera 3 but they are operating within an optimal temperature range.

# 2.1.2.3 On-Board Masking

To quantify the improvements of onboard masking of Camera 3, noise estimates were made using orbit-differenced images, i.e. an image where the previous orbit was subtracted. Since this image product is primarily used for tracking CMEs, this approach will give an estimate of the faintest CME detectable by SMEI. A section of a Camera 3 imaged area was used for this analysis which was relatively devoid of large stellar residuals from the subtraction process as well as any noticeable transients. These types of residuals can be large and produce "outliers" in the noise distribution which, in turn, affect the statistical measurements. Several patches were taken both before and after the mask was applied. The differenced pixels were plotted in a histogram and then fit with a Gaussian. The standard deviation of the Gaussian distribution gives a direct measurement of noise and the likely detection limit of a CME. The results show a reduction in the noise by nearly a factor of two, after the mask was applied. The values of the standard deviations, pre- and post- mask application, were 1.01 and 0.55 ADU. Thus the detection threshold  $(3\sigma)$  for onboard masking of camera 3 is approximately 1.7 ADU. We continue to use on-board masking despite its consequences for some of the collateral observations, such as stellar photometry. The improvement to Camera 3 observations could be seen in a recording of the 6 December 2006 limb event, the first CME seen in the Camera 3 FoV since implementation of the mask.

## 2.1.3 DHU-A FAILURE AND CURRENT STATUS

SMEI telemetry was lost a few hours after onset of an anomaly coincident with passage through the South Atlantic Anomaly (SAA) on 31 March 2006. Attempts to recover DHU-A, including: power cycling of DHU-A, exercising all eight copies of the boot-up software, attempting 'blind' commanding to switch on the de-icer heaters, using the spacecraft PDU-B to issue a relay command to switch on DHU-A, and using the spacecraft MIL-STD-1553B bus B rather than bus A were unsuccessful. The failure was likely because of accumulated radiation damage, probably to the DSP processor itself.



Figure 8. Recording of the 6 Dec 2006 CME Event by Camera 3, after Implementation of the Hot Pixel Masking. The CME is the white arc at the bottom left.

Current Status: SMEI remained in a switched off mode (except for brief periods for recovery attempts) for nearly a month (commencing 31 March 2006). There was some risk to the optics in the cameras if sunlight penetrated to the surfaces because of an accident at the integrating facility during testing. Unfiltered compressed air was pumped into the experiment that could have laid down a hydrocarbon coating all the surfaces. When sunlight, mostly UV, hits such a material the coating can become opaque. With camera shutters almost certainly open, and further diagnostic tests exhausted, DHU redundant side B was powered up. As of this report date, SMEI, operating on the B-side is working nominally.

## 2.2 Data Processing

The real time data processing for SMEI was handled in-house at AFRL. A detailed description follows in section 2.2.1. The University of California – San Diego team spent considerable time working individual images for the best background subtraction possible. Their technique is described in Section 2.2.2.

## 2.2.1 AFRL PIPELINE PROCESSING TECHNIQUE

The AFRL pipeline (composite image) processing consists of a series of procedures that ingests the telemetry data, performs quality checks on the data, corrects the data for various instrumental and external effects, and creates several all-sky images for each orbit. The end product is a set of five Hammer–Aitoff images created for each orbit: an image derived from weighted input values, a FITS plane of the weights, an image of the observed sky using all the data, the same image using only "good" data, and a fifth image from which the stellar and zodiacal contents have been subtracted. The pipeline is able to process a day's worth of data in less than a day. AFRL provided the basic real time processing of the images, including "quick-look" images for forecasting purposes. This work was performed by Boston College contractors, Drs T. Kuchar and D. Mizuno.

# 2.2.1.1 SMEI Image Products

The end products of the SMEI processing pipeline are single orbit images in several sky useful projections. Each sky projection was chose to fulfill a specific mission requirement. The three standard projections are:

- 1. High resolution (0.2 degree/pixel) all-sky cubic projection in celestial (equatorial) coordinates.
- 2. Low resolution (0.5 degree/pixel) all-sky Hammer-Aitoff in (observer) ecliptic coordinates
- 3. Low resolution (0.5 degree/pixel) hemispherical "fisheye" projection in (observer) ecliptic coordinates

Each image conforms to the FITS astronomical standard (*Calabretta and Greisen*, 2000). All the images contain at least two data planes. The first of these consists of (Image data) × (statistical weights) and the second contains the statistical weights. This format was chosen to provide a quality estimate of each pixel. The statistical weights are the weighted sum of the number of CCD pixels at that sky location. The final image can be obtained by dividing the first plane by the second. Some of the sky projections contain additional image planes (described below) to aid image analysis. The image file names indicate the projection type, the observation date and orbit duration: PPP\_yyyy\_ddd\_h1m1s1\_h2m2s2.FIT, where PPP is the projection, yyyy is the year, ddd is the consecutive day of the year (DOY), h1m1s1 is the UT start time of the orbit and h2m2s2 is the elapsed time.

## 2.2.1.2 Cubic Projection

This image projection is the SMEI archival product. Its pixel size is equivalent to that of the CCD data binned in science mode. Thus it contains sufficient resolution to produce any (lower resolution) sky projection that is not readily available. The cubic sky projection chosen for the archive is the "spherical cube" developed for the Cosmic Background Explorer (COBE, see *Calabretta and Greisen*, 2000, for a mathematical description of this projection). This projection attempts to minimize the edge distortion

that is prevalent in all spherical cube type projections. Image file names of this type are denoted by CSC (COBE spherical cube).

# 2.2.1.3 Hammer-Aitoff Projection

The equal area Hammer-Aitoff projection is used for displaying an all-sky image in which the brightness of a unit area is preserved regardless of the pixel distortion. Image file names of this type are denoted by S. These images are cast in ecliptic coordinates centered on the sun (the longitude coordinate of the image center is rounded to an integral value of the solar ecliptic longitude). This is the natural coordinate system for detecting and tracking heliospheric transients that originate on the Sun. Each image file contains 6 image planes to meet this end:

- 1. (Image data) × (statistical weights)
- 2. Statistical Weights
- 3. Orbit recast in previous day's astrometry (*i.e.* centered on [current solar longitude 1°])
- 4. Current orbit Image (i.e,. plane 1/plane 2)
- 5. Image with absolute star map and zodiacal model subtracted
- 6. Image with a mean orbit map subtracted

Image planes 1 through 4 are provided for consecutive orbit differencing to remove the celestial backgrounds. This is an efficient way to detect fast moving transients. To \*\* facilitate this type of image differencing, the ecliptic longitude of the image center is set to an integral value for the current day. To avoid an astrometry shift from comparing orbits that may overlap a two-day period, the Aitoff files contain the current day's data projected in the previous day's ecliptic longitude (image plane 3). The value of the current day's longitude is contained in the FITS header parameter CTYPE1. The flux of a transient may not be preserved using consecutive orbits, if the transient does not move sufficiently from orbit to orbit.

Plane 5 contains an image with a standard stellar background and zodiacal emission already removed. This is useful for slower moving transients that may not move sufficiently to be detected with the above image differencing method. The flux of the transient is preserved in this method, however, camera and other systematic artifacts remain in this image. Future improvements in processing will account for these effects, allowing their removal.

Plane 6 contains an image where a mean background was determined from 5 previous orbits. This method was devised to reduce the effect of single-orbit transitory effects (e.g. aurora glow and particle contamination from the auroral zones and the South Atlantic Anomaly) that can be worsened in consecutive orbit subtraction. It can also aid in the detection of slower moving transients as well as preserving their flux.

# 2.2.1.4 Fisheye Projections

To reduce projection distortions at the ecliptic poles the SMEI data are also imaged as "fisheye" projections (i.e. zenithal equidistant, mathematically described in Calabretta and Greisen, 2000) which maintains a constant angular scale along the radius of the image. These images are also Sun-centered ecliptic coordinates with a radius of 135° about the Sun. Each image file contains four image planes, similar to those in the Aitoff images for consecutive orbit subtraction. Image file names of this type are denoted by F.

A second version of the above fisheye images is produced to help aid in "real-time" space weather forecasting. These "quick" images only contain data from cameras 2 and 3 and do not incorporate enhancements found in the Aitoff or the other fisheye images. They also contain only two image planes (i.e. the first two planes found in the Aitoff and \*\* fisheye images) cast in the current day's ecliptic longitude. Thus these images require significantly less pipeline processing time. These image file names are denoted by ARC.

#### 2.2.2 UCSD PROCESSING

Detailed image processing using both pre- and post-data to remove background was accomplished by UCSD contractors. A description of their techniques follows in Sections 2.2.2 to 2.2.5. Further details can be found in Jackson et al 2004.

# 2.2.2.1 Data Frame Conditioning

The basic corrections to the data in the pipeline processing are as follows:

- 1. *Rice-corrupted pixels*: Up to four of the final pixels in the data stream for a frame may be corrupted by the Rice compression. These pixels are removed from consideration..
- 2. Bad pixel mask: A bad pixel mask is determined from weekly on-orbit calibrations. Approximately one third of the pixels in camera 3 are identified as "hot" or "flipper" pixels due to the elevated focal plane temperatures. These pixels are omitted from further processing.
- 3. Moon and planet detection: Entire frames contaminated by the Moon and Venus are flagged as bad so that they can be discarded. 4. Saturation detection: Regions of excessive pixel saturations and anomalously elevated levels are checked and affected frames are flagged as bad so that they can be discarded.
- 5. Position tagging: The pixels are assigned right ascension and declination coordinates.
- 6. Dark offset removal: The bias and dark charge are computed from the appropriate columns and removed from the data.
- 7. Spike detection and removal: Pixels with locally anomalously high values are detected and flagged in a bad pixel mask applied to each frame.
- 8. Large scale flatfields: UCSD flatfields are applied.
- 9. On-board flat-field equalization: Frames that have not been flat-fielded onboard the spacecraft are multiplied by 0.75 to make them consistent with data frame levels where on board flat fields have been applied.
- 10. Geometric corrections: Focal plane projection effects as described by UCSD are applied.

- 11. Excessive median-gradient detection: Normally the median of the response distribution does not increase by more than about 1ADU from frame to frame for a given camera. Frames whose median increases by more than 10 ADU from the previous frame are flagged as bad so that they can be discarded.
- 12. Sub-sampling the focal plane: Only half (2.5°) of the data from the 5°-wide in-scan field of regard of the CCD that is transmitted from the focal plane is used in the imaging. The accepted data were identified by the UCSD flat field corrections.

# 2.2.2.2 Image Construction

A relatively high-resolution all-sky map image is constructed from the position tagged data, for each orbit, in a fixed projection that (ideally) would have no preferred direction. This image is then re-sampled onto the (lower resolution) Sun centered Hammer–Aitoff projection. An advantage to this approach is that we can easily re-project the higher resolution image created from given orbit into different representations since the re-sampling is a faster operation than the basic image construction. This is useful, for example, in using difference images between successive orbits to identify transient phenomena such as CMEs, as we can always make two orbits in the same sidereal projection, which is necessary to remove stars in the difference image.

The COBE Quadrilateralized Spherical Cube (CSC) (Calabretta and Greisen, 2002 defined the CSC FITS standard) is used for the high-resolution fixed projection images. This is a projection in which the sky is divided into six flat square faces. The projection for each face is designed such that the distortion and deviations from the pixel equal-area condition are minimized. The 12 arc min (0.2°) pixel size of the SMEI science data is adopted for the pixel size in these high-resolution images.

The point response function is quite asymmetric especially in the in-scan direction. Since the 1° program requirement for resolution allows data smoothing, one can use the transpose of the point response function to smooth the data while projecting it onto the COBE cube. Such smoothing of the data produces an ovoid shape for the point response function with axes of about  $1^{\circ} \times 0.5^{\circ}$  in the in-scan and cross-scan directions, respectively. The transpose response function is smoothed with a 0.9° box averaging in the cross-scan direction such that the point response function is circularly symmetric after the filter function is applied to the data. The filter function is centered on each of the COBE cube pixels and the observations immediately around that point are averaged with weights defined by the filter function. Thus, the transpose plus cross-scan averaged filter function not only smoothes the data but projects it on the proper grid. A Hammer-Aitoff image is created for each orbit with the Sun at the center of the image. A 0.5° pixel for the Hammer-Aitoff images is selected, as this is the Nyquist sampling interval for 1° resolution specified by the program. The ecliptic coordinates of the Sun are rounded to the nearest integer and the data is projected onto the Hammer-Aitoff image with 0.5° pixel spacing using a smoothing filter. The final Hammer-Aitoff files contain 5 image planes: the "weighted data" and "weights" planes for the "good data" only (these planes are the actual products of the image construction process), the "good data" and "all data"

images in true sky values (dividing the weighted-data plane by the weights plane), and the background subtracted image.

# 2.2.2.3 Galactic Background Subtraction

Camera 1 and 2 measurements were obtained from orbits sampled approximately every 10 days over a 108-day period. The observations were filtered with the modified transpose of the point response function and imaged onto a COBE-cube. The major planets have also been removed by excising a small box around them. After removal of the zodiacal light model, the processed images are averaged together. The result is a COBE-cube representation of the sidereal sky. This image is subtracted from each COBE image for a single orbit and the result is re-gridded to the Sun-centered Hammer–Aitoff projection.

# 2.2.2.4 Zodiacal Background

The zodiacal module of the Celestial Background Scene Descriptor (CBZODY 6 – Noah and Noah, 2001) is used to compute the zodiacal background. The module includes a modified form of the Reach, Franz, and Weiland (1997) dust bands component, which was found to predict too much infrared flux at smaller elongations (Price *et al.*, 2003) and in the SMEI observations. Thus, only the cloud component is used. The zodiacal model is computed at the pixel centers of the Sun centered Hammer–Aitoff projection for a given orbit, rather than the COBE cube, as the scale lengths for this phenomenon are large and this significantly improves the speed of calculation. Since the predicted zodiacal image is computed in units of MJy sr–1, the best fit scaling between the model and observations provides an initial calibration, 1 MJy sr–1 = 1250 analog to digital unit (ADU).

## 3. OPERATIONS

The SMEI experiment was launched from Vandenberg AFB on the last Titan II rocket to be sent into space. It shares the Coriolis spacecraft with the primary experiment, WindSat, operated by the Navy. Spectrum Astro, Inc. was the spacecraft vendor. ??? Integration and testing were accomplished first at the [SAI] facility in Gilbert, AZ, then ? moved to the Naval Research Laboratory facility in Washington DC. The first year of the Coriolis mission was operated by the Air Force Space Test Program (STP), and then operations transferred to the Navy IPO control. The Navy continues to provide SMEI data to the AFRL Space Vehicles Directorate at no cost to AFRL.

In 1999 AFRL management of SMEI passed from Dr. S. Keil to Dr R. Radick and Ms. J. Johnston. Mr. P. Holladay is the current Systems Engineer and Chief of Operations, replacing Mr. P. Anderson (Boston University) in 2003. Lt S. Figueroa assisted with integration, testing and early operations. Lt J. Hewitt served as Chief of Operations from 2005 to 2007. Drs T. Kuchar and D. Mizuno (both of Boston College) wrote the SMEI real time processing software to generate the all-sky maps. Ms Johnston currently serves as the Program Manager and Principal Investigator. SMEI data is currently archived at

the AFRL Sunspot, NM facility and current and archived sky maps and movies appear on a website.

Since the launch of Coriolis, SMEI operations have been performed by STP's RTD&E Support Complex (RSC) at Kirtland AFB, NM, in coordination with AFRL. The first month of operations included extensive real-time commanding to initialize the instrument components, open the Camera Doors, perform thorough checkout procedures and calibrate the instrument. Since that first month, nominal commanding has been accomplished using stored commands in text files (called tasking files) transferred [to the \*from the\*] RSC [from \*to\*] SMEI via ftp. The commands in these files execute \*\*\* weekly calibration, periodic special observations, and Camera CCD anneals as needed. As noted in Section 2.1.2.1 (DHU Processor Performance), SMEI experiences anomalies, on average, every 1 – 2 weeks, often traced to Coriolis transits of the South Atlantic Anomaly (SAA). The typical response to these anomalies is to request that the RSC to perform a reset of the SMEI DHU by executing a real-time command procedure; these requests are recorded in documents called memograms. In addition to causing anomalies, the SAA also corrupts the images of all three cameras. Hence, special observations, such as weekly calibrations, are planned for orbits that don't traverse the SAA.

Each SMEI Camera may collect images in any of a number of modes, depending on the purpose of the observation. The historical record of what specific mode each of the cameras was in at a given time since launch is a spreadsheet called the Configuration Log (config log.xls, see Appendix C). The log lists date and time, mode number, mode parameters, observation duration, and any associated comments for each observation. A brief description of each column of the spreadsheet is provided below.

- Rev # or UTC(hex): lists either the orbit number (since launch) or the time (in seconds since epoch, hexadecimal) of the start of the observation.
- Date
- Julian Day
- Time (Zulu)
- Camera parameters
  - O Mode: Pre-defined mode number (0 through 15) or Dynamic Configuration mode number (DYNxxx). Mode 0 corresponds to the cameras being powered off; Mode 1 corresponds to the camera in Standby Mode. Specifics of each mode are listed in the subsequent parameters.
  - o CCD Bin'g: The cameras may operate at three distinct resolutions, defined by how the CCD pixels are binned in producing the image. Normal binning mode takes a 4 × 4 bin of pixels and combines their response into one value. High-Resolution binning mode combines a 2 × 2 bin into one value. Engineering binning mode includes every pixel in the image (1 × 1, or no binning).
  - ROI: Region Of Interest. An image may consist of all the pixels on the CCD, or a subset of those pixels forming a region of interest. The region of interest is typically slightly larger than the image that the aperture casts on the CCD via the camera optics.

- o FF Correction: Flat Field Correction. A gain value can be applied to each pixel to account for variations in response to a flat input. These gain values are stored in a table; applying this table of gain values is a function that can be turned ON or OFF according to this parameter. For Camera 3, this functionality has been utilized to mask (i.e., setting gain to zero) hot pixels.
- Shutter position. There is a motor-controlled shutter over each camera's aperture that automatically closes to protect the optics when a bright object is detected by that camera's Bright Object Sensor. The shutter is also intentionally set to one of its closed positions in certain operational modes to collect images that are used to determine the Flat Field Correction gain values. This latter function is what is tracked in the Configuration Log. This parameter can be set to OPEN (where the shutter only closes when triggered by the BOS), or to one of the closed positions (CLOSED or FF). In the CLOSED position, the CCD sees a dark shutter, providing a dark (or Low) flat field. In the FF (Flat Field) position, the CCD sees a white shutter, which, when illuminated by the Flat Field LED (inside the camera box), provides a bright (or High) flat field.
- FF LED: Flat Field LED (Light Emitting Diode). Set to be ON or OFF.
   Used in conjunction with the FF shutter position to provide a High flat field. Note that a Medium Flat Field can also be configured by having the CCD image an illuminated dark shutter.
- O De-Icer set point: Each camera's CCD has a heater (called a DeIcer Heater) and a thermistor that can be used to maintain the CCD at a certain temperature. These were set high (+30°C) soon after launch to protect the camera optics from contamination during orbit raising. For normal observations, the set point is kept low enough so that the heaters don't turn on (-50°C). As camera performance has degraded with time (especially in the case of Camera 3), the DeIcer heaters have been used to anneal the CCDs, which reduces the number of hot pixels, thus improving cameras performance. To anneal, the DeIcer heater is set to be continually on (100% duty cycle) for a period of time (nominally 12 hours).
- Observation Duration (in units DD:HH:MM)
- Comments

Note that the Configuration Log has also been used to document SMEI anomalies, Spacecraft anomalies, and significant WindSat events and anomalies, each described by a color-coded entry in the Comments section.

Another aspect of operations is the science data downlink via X-band and the delivery of that data to AFRL via CoDDS (the Coriolis Data Delivery System). Coriolis science data is downlinked using two ground stations--one in Fairbanks, Alaska, and the other in Svalbard, Norway. Early in the mission, it was decided that all SMEI data should be automatically redumped once, due to frequent issues with the X-band downlink. Utilizing this scheme, data gaps are infrequent. The SMEI data latency spec of six hours is nominally met by CoDDS, but the occasional excessive latency can be attributed to one

of a few effects. First, occasionally Coriolis gets bumped from its scheduled X-band contacts, deferring to higher priority programs; because our SMEI's redump strategy--the resulting long interval between dumps produces large data files that clog the CoDDS data pipe. Then there are also data delays due to CoDDS hardware issues (faulty components). The net result of this is a data downlink and delivery system that is adequate for a proof-of-concept type program; were an operational equivalent to SMEI to be pursued, a more reliable system should be pursued.

## 4. SCIENTIFIC RESULTS

SMEI's mission is to demonstrate that CMEs can be tracked across the inner heliosphere and lead to improvements in space weather forecasting (Jackson et al. 2004).

Appendix A is a list of scientific papers and articles on SMEI and SMEI scientific results published to date. Besides mission applications, SMEI's unique dataset has provided insight into CME morphology and driving forces, interactions between comet tails and the heliosphere, zodiacal light, stellar variability and high altitude auroral phenomena. SMEI also observes asteroids and orbital debris and has demonstrated a capability to observe resident space objects (RSOs) such as other satellites.

# **4.1 Coronal Mass Ejections (CMEs)**

CMEs are huge blobs of plasma, sporadically ejected from the Sun in all directions. Their frequency varies from high in solar max to low during min. Their speeds vary from one to three days to travel over 1 A.U. distance. They are significant triggers of potentially hazardous geomagnetic storms. Such storms can damage spacecraft, disrupt communication/navigation, overload power grids and expose astronauts to harmful radiation. Detection and tracking of CMEs en route to Earth is critical for accurate space weather forecasting.

However, CMEs are extremely dim and observing them at any distance from the Sun is very difficult. SMEI was carefully designed with baffles to reject stray light in order to see CMEs (extended sources) to 10<sup>th</sup> magnitude. (It sees point sources to roughly 8<sup>th</sup> magnitude). Appendix B is a list of CMEs compiled to date by the SMEI team.

## 4.1.1 STATISTICS

At the four-year mark, SMEI has observed over 300 CMEs, ~30 of which have been geoeffective (caused geomagnetic storms at Earth). Webb et al (2006) compiled a list of CMEs and their characteristics for the first year and a half of the SMEI mission. They found:

# Categories by Fractions of CMEs Observed by SMEI

A) Limb CMEs	50%?
B) Erupting prominences with CMEs	>4% (>6)
C) Multiple CMEs	25%

D) Distant wide arcs ~30%
E) Concave-outward V-shaped CMEs 3% (4)
F) Earthward ("halo") CMEs ~30%

#### and

- SMEI observed 139 CMEs in 1.5 years and 204 CMEs in 2.5 yr Estimated observation rate = 0.3 CMEs/day
- Brightness: Mean = 1.7 S10 units (range = 0.4 10 S10)
- Spans: Mean >  $40^{\circ}$ ; Range =  $3^{\circ} 113^{\circ}$
- Durations: Mean 16.3 hr; Range = 3.5 70 hr
- Speeds: Angular Mean = 1.1°/hr P-approx. mean = 473 km/sec, range 51-1611 km/sec

#### 4.1.2 MORPHOLOGY

Most of the SMEI events are likely to be associated with solar coronal mass ejections (CME), which are routinely monitored by SOHO/LASCO. In the period February 2003-September 2005 SMEI observed 171 events at times when there was good LASCO coverage. However only 120 of these events could be reasonably associated with a LASCO CME (Simnett and Howard, 2006). A further 24 occurred in association with a very weak feature seen in LASCO, which would not have been expected to propagate to the location observed by SMEI without very significant acceleration and mass concentration. The remaining 27 events were not associated with any detectable feature in LASCO. Approximately 70% of the positive associations had LASCO (projected) CME speeds between 200 and 600 km/s, while only 19% were associated with LASCO CMEs above 1000 km/s.

Howard et al (2006) tracked two events through LASCO within 30 R<sub>Sun</sub> and then later as Interplanetary CMEs (ICMEs) through SMEI from 80-150 R<sub>Sun</sub>. Both events were also associated with erupting filaments, followed by post-eruptive arcades that were observed by EIT, providing information on the three-dimensional (3D) direction of propagation. Assuming radial propagation, this allowed 3D reconstructions of the CME/ICME geometry, along with corrected (not sky plane projected) measurements of the distancetime (d-t) plots for each event out to ~0.5 AU. Comparing CME/ICME images in LASCO and SMEI showed that the curvature becomes more sharply concave outward (i.e. the curvature is away from the Sun), suggesting that the ICME footprints remain fixed to the Sun even at 0.5 AU. They also considered two models describing the evolution of the CME/ICMEs at large distances from the Sun: Aerodynamic Drag and Snow Plow models. There was little difference between these, and their d-t profiles matched well with the SMEI data for the first event. The second event showed a net acceleration between the LASCO and SMEI fields of view. The data can be matched for this event well by introducing a driving Lorentz Force to the drag models. ICME mass almost doubled as a result of swept up solar wind material from the Snow Plow model.

## 4.1.3 SPACE WEATHER APPLICATIONS

Most relevant to SMEI's original space weather forecasting mission:

- Addition of SMEI data into forecast models as a "mid-course correction" improves forecasts by greater than 30%
- SMEI observes a CME in advance of 85% of all moderate to intense geomagnetic storms
- In the first 1 ½ years, SMEI detected ~20 halo CMEs at ~1/3 of Sun to Earth distance and can detect CMEs 10 hours to 1+ days before Earth arrival
- CMEs can travel with constant speed, be decelerated, or may actually accelerate from the Sun to the Earth, making continuous observation of them critical
- Multiple CMEs ejected at the Sun may morph into a single wave front arc at distance

# 4.2 High Altitude Aurora

When SMEI transmitted its first images of Earthbound CMEs the SMEI team was surprised by the auroras, and in fact did not recognize them as such because the viewing geometry of SMEI was not expected to suffer from auroral obscuration of its FoV of the inner heliosphere. Mizuno et al (2005) studied this phenomenon with SMEI data; their characteristics are summarized below:

- Mainly seen during passages through polar cap regions
- Aurora observed at 840 km altitude and some examples suggest columnar material extending to 2000 km or higher
- ~1000 examples observed in first year of operation
- Commonly observed at Kp > 2, ubiquitous at Kp > 6
- Surface brightnesses a few tens of Rayleighs to several kR
- Some (24%) observed in the absence of CMEs

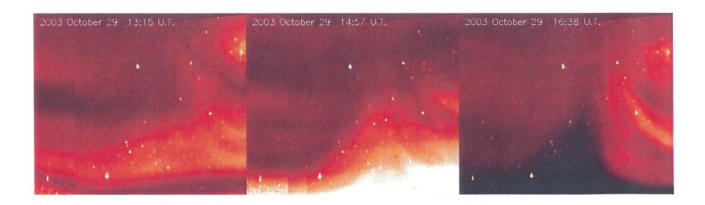


Figure 9. SMEI Observations of High Altitude Auroras, 29 Oct 2003

Any future CME tracker in Earth orbit would have to be designed to mitigate effects from auroras.

#### 4.3 Comet Tail Disconnections

The Solar Mass Ejection Imager (SMEI) observed three bright comets during April-May 2004: Bradfield (C/2004 F4), LINEAR (C/2002 T7), and NEAT (C/2001 Q4). Investigation period reveals that two of the comets showed continual changes in their \*\*\* plasma tails. These changes are characterized by a "smokestack-like" billowing effect punctuated by the disconnections. Bradfield however was remarkably quiescent during this entire period. Also observed were spectacular tail disconnections. These observations, including the first of a CME interaction with a comet tail leading to a disruption of that tail are described in Kuchar et al. (2007, submitted). SMEI's data base is unique for large scale (some 30-40 degrees elongation) comet observations.

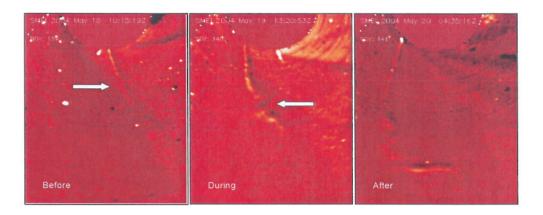


Figure 10. SMEI Observations of a Comet Tail Disconnection Event, 18 May 2004

## 4.4 Zodiacal Light

The SMEI visible-light cameras provide a photometric sky map for each 102-minute orbit with the objective to observe transient Coronal Mass Ejections (CMEs). Zodiacal light is a significant contributor to these maps and must be removed in the data analysis in order to detect and characterize the much fainter CMEs. Over three years of the SMEI calibration data that were taken at the highest spatial resolution were analyzed to derive the yearly averaged global distribution of zodiacal light between solar elongations of 20° and 180°. Residuals on the individual sky maps from this global average provide information on the detailed geometry of the clouds. Preliminary results of the analysis include a characterization of the Gegenschein, possible dust bands, and annual variations (Buffington, et al. 2005).

# 4.5 Stellar Photometry - Variable Stars

The unique SMEI dataset of continuous monitoring of the entire sky has been used to study variations in the brightnesses of stars. A new reduction and analysis method has

been used to study the Cepheid star Polaris, to take part in the discovery and study of the eclipsing binary (Penny, 2006).

# 4.6 Open Questions

At the time of this report, the SMEI scientific team was investigating these questions:

- What happens in the gap region between coronagraph observations and SMEI?
- What causes the chevron-shaped features? (Kahler and Webb, 2007)
- Why are some CMEs viewed by SMEI but absent in LASCO?
- Why does SMEI detect fewer CMEs than LASCO?
- What causes high altitude auroras when no CME is present in SMEI?
- What causes the 15% of geomagnetic storms for which SMEI does not observe a CME?
- What causes some CMEs to just "appear" in SMEI, camera 2?
- Which dominates CME brightness: expansion of the plasma, proximity to Sun or to the Earth, Thomson scattering sphere?
- What is the driving force behind CMEs that do not decelerate and may even accelerate through the inner heliosphere?

#### 5. LESSONS LEARNED

#### 5.1 Thermal

The thermal issue with Camera 3 has plagued SMEI through its mission life. Post-launch reviews of the problem by the designers and STP consultants never revealed the flaw in thermal design, however, two major factors contributed, in the author's opinion. One, despite our best efforts at requesting ITAR permission to pass information about the spacecraft interface to the British designers/builders, this critical information was delayed and initial thermal testing proceeded without it. Secondly, because of cost limitations, the payloads were never tested with a simulated sun source. Further, the thermal design was late and could not be properly reviewed by the panel of experts at the SMEI Critical Design Review (CDR). Thermal design should have been reviewed at a supplementary CDR at a later date.

Specific suggestions to correct the design include:

- Reduce thermal conductivity along baffle stack and between baffles and camera strongbox.
- Pay more attention to parasitic thermal loads between CCD and surroundings.
- Use thermo-electric cooler (2-stage Peltier) for CCD. (Peltier coolers were included in the original SMEI design but were later eliminated based on predicted cool temperatures.

The SMEI uses the instrument's heaters to anneal the cameras to alleviate some of the thermal effects, especially to Camera 3. Also, an on-board mask is applied to Camera 3 pixels before binning and transmission to Earth. While the masking makes CMEs easier

to detect and track, masking will have undesired consequences for other SMEI studies, such as CME intensity or stellar variability.

# 5.2 Electromagnetic Emission

SMEI failed to meet the required E&M emission specification. There was concern that SMEI would interfere with Windsat operations. With the help of Aerospace consultants to the Space Test Program (STP) emissions were reduced, not to spec, but to a level that did not interfere with the primary payload.

#### 5.3 Aurora

The high altitude auroras observed by SMEI (sec 3.2) were completely unexpected and although a scientific discovery, render parts of SMEI sky maps useless for CME observation. If the auroras have a predominant colour, it might possible to design a filter to reduce their camouflaging effect on the sky. Their appearance does aid assessment of geoeffectivity of incoming CMEs, however.

#### 5.4. Radiation/Particles

A major problem with the SMEI design/orbit combination is the impact of particles when crossing the South Atlantic Anomaly (SAA) and the auroral bands. This obscures large portions on the sky maps on several passes per day. A transparent window over the optics would likely diminish this to acceptable levels. A future imager based on the SMEI design might use an additional camera or employ a mechanism to change the viewing angle to capture what was missed while the imager was in the high particle zones.

# 5.5 Point Response Function (PRF)

SMEI mission requirements dictated a fast optical system that could image large areas of the sky with a differential photometric accuracy of 0.1%. This was accomplished by using a folded optical path that could image a large field of view on SMEI's large CCD array. Since the resolution requirement was about 1°, the optics were de-focused to produce stellar images (point sources) to that size. However, the folded light path produced a point response function (PRF) that was highly structured, approximately triangular in shape, and varied in size over the CCD array.

Unfortunately an asymmetric and variable PRF compromised the star subtraction process needed to detect CMEs. Various methods, including a symmetrization process and long baseline background images, were used to compensate for this, but bright stars (brighter than 6th magnitude) continued to pose problems as they typically left 20% residuals after star subtraction regardless of the processing method. Future designs that require low star subtraction residuals over long baseline periods need to employ a PRF that is symmetric and regular over the CCD array.

# 6. IMPLICATIONS FOR FUTURE (OPERATIONAL) DESIGNS

White-light heliospheric observations from the Solar Mass Ejection Imager (SMEI) experiment have shown that the structure and propagation of coronal mass ejections (CMEs) in the heliosphere are more complex than previously assumed. SMEI has operated routinely since January 2003 and is still the only instrument recording CMEs with nearly all-sky coverage.

Because all space weather is initiated by the Sun, it is critical for the Air Force to understand processes at work and their effects from the Sun. Basically, it is a study of the *forward* problem, any improvement in which will lead to multiplicative improvements downstream in actual Air Force applications, such as prediction/forecasting of occurrence, type, intensity, and duration of effects.

SMEI, despite limitations on data latency, particle hits, auroral interference, Camera 3 thermal issues, and DHU anomalies demonstrated a 30% improvement in arrival time forecasting. New designs and mission concepts should be able to raise this to 50%. The Space Environmental Effects Monitoring System, proposed for the FY10 POM cycle, includes heliospheric imagers (HIs) as part of its Spiral Three step.

It is possible to design an HI that will work in several different orbits. LEO will have to overcome the radiation environment through the SAA and auroral bands. Protective windows, an extra camera or a tilting mechanism would be needed if a SMEI-like design were employed (such a design we have named "SMEI-OV"). Use of numerous, lightweight, partial field of view instruments, employed in different orbits (COVI – Compact, Orbit-Versatile Imager) is at the other end of the spectrum. With greater resources, imagers placed at L1, or L4 and L5 (for off-center viewing) might be employed as well as the "solar diamond" orbit that places four satellites in solar orbit but encircling the Earth at 0.1 AU. to keep one between the Earth and the Sun at any given time.

## 7. CONCLUDING REMARKS AND RECOMMENDATIONS

Although CMEs are a major solar and heliospheric phenomenon, their structure and propagation through the heliosphere remain poorly understood. Until recently, modeling was the main method available to try to physically approximate the evolution of a CME into the interplanetary medium. Such models use input parameters obtained at the Sun by coronagraphs and X-ray, EUV, H-alpha and radio data to predict the arrival of the CME at 1 AU. Such models are often utilized by the space physics community for space weather forecasting. Complexities in the interaction of the IP medium and the ICME are generally ignored due to the lack of data on the propagation of the ICME between the Sun and Earth. Until recently, with the exception of studies using Helios photometer and interplanetary scintillation (IPS) data, observations of ICMEs between 30Rs and one AU have not been available. The Solar Mass Ejection Imager (SMEI – Eyles et al., 2003, Jackson et al., 2004) now provides us with measurements of ICMEs in this region, and has observed over 300 transients since routine observations became available in February, 2003.

The Solar Mass Ejection Imager attained remarkable success on a relatively small budget (~\$10M for the instrument). It brought the first detailed heliospheric images of CMEs to the scientific community. Its unprecedented database of a full-sky image every 102 minutes for five years has utility for a wide range of research areas.

SMEI demonstrated the practicality in white light heliospheric imaging, detection and tracking of CMEs for space weather forecasting and basic research in CME phenomenology. SMEI was and is a pathfinder for future DoD operational capability.

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## APPENDIX A

#### **Publications**

<u>LIST OF PUBLICATIONS, PRESENTATIONS AND PRESS COVERAGE ON THE</u> <u>SOLAR MASS EJECTION IMAGER (SMEI) – AFTER 2000</u>

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- \*M Tokumaru, M Kojima, K Fujiki, M Yamashita, B V Jackson, P Hick, "Three-dimensional structure of compound interplanetary transients associated with 27-28 May 2003 coronal mass ejections"
- \*B V Jackson, A Buffington, P P Hick, and the SMEI Team, "Heliospheric Photometric Images and 3D Reconstruction from the Solar Mass Ejection Imager (SMEI) Data"
- \*D F Webb, "CMEs Observed in the Heliosphere by the Solar Mass Ejection Imager (SMEI)"
- \*T A Howard, G M Simnett, I M Robinson, J Tappin, "Earthbound and Geoeffective CMEs Observed by the Solar Mass Ejection Imager (SMEI)"
- \*M J Reiner, B V Jackson, D F Webb, M L Kaiser, E W Cliver, J L Bougeret, "Wind/WAVES and SMEI Observations of ICMEs"
- \*D R Mizuno, "Observations of High Altitude Aurora With the Solar Mass Ejection Imager"
- \*A Buffington, B V Jackson, P Hick, "Systematic Error Reduction and Photometric Calibration for the Solar Mass Ejection Imager (SMEI)"
- \*J C Johnston, J B Mozer, R R Radick, P E Holladay, T A Kuchar, D R Mizuno, D F Webb, "Heliospheric Imagers for Tracking Coronal Mass Ejections: Lessons Learned from the Solar Mass Ejection Imager"

#### Poster Session:

- \*I M Robinson, G M Simnett, J Tappin, "Using SMEI Observations to Constrain Levels of Interplanetary Scattering for Energetic Protons"
- \*G Simnett, S Kahler, "Imaging of Interplanetary Disturbances Causing Forbush Decreases"

- \*B V Jackson, A Buffington, P P Hick, M Kojima, M Tokumaru, "Comparison of Solar Mass Ejection Imager (SMEI) White Light Observations with IPS Velocity"
- \*J Tappin, G M Simnett, B V Jackson, "The Deceleration of Interplanetary Transients Between the Sun and 5 AU"
- \*R A Jones, A R Breen, R Fallows, M Bisi, G Lawrence, "Interplanetary Propagation Of Coronal Mass Ejections: Results From Interplanetary Scintillation Observations Using EISCAT"
- \*T A Kuchar, D Mizuno, C N Arge, D F Webb, S W Kahler, J C Johnston, "Comet Tail Disconnections Observed by SMEI"
- \*C J Eyles, J Tappin, A Buffington, "Compensating for the Effects of hot Pixels in the Sunward Camera of SMEI"
- \*S Simon, B V Jackson, A Buffington, P P Hick, A Smith, "Zodiacal Light Analysis and Removal From the Solar Mass Ejection Imager (SMEI) Data"
- \*R M Skoug, J T Gosling, J T Steinberg, D J McComas, "Characterization of 90 degree depletions in solar wind suprathermal electrons as a function of radial distance and latitude using Ulysses/SWOOPS observations"

## Abstracts (SMEI-specific) for the AAS Meeting, Jan. 9-13, 2005, San Diego, CA.:

- B. V. Jackson, A. Buffington, P. P. Hick, X. Wang, "Preliminary Three Dimensional Reconstruction of CMEs Using Solar Mass Ejection Imager (SMEI) Data"
- P. P. Hick, A. Buffington, and B. V. Jackson, "Near Real-Time Photometric Data Processing for the Solar Mass Ejection Imager (SMEI)"
- Buffington, A. Smith, B. V. Jackson, and P. P. Hick, "Photometric Calibration for the Solar Mass Ejection Imager (SMEI)"
- C.X. Wang, P.P. Hick, B.V. Jackson (UCSD/CASS), "Interactive Visualization of Solar Mass Ejection Imager (SMEI) Volumetric Data"

# SMEI Abstracts for the Spring AGU Meeting, May 23-27, 2005, New Orleans, LA:

- B.V. Jackson, A. Buffington, P.P. Hick, Y. Yu, D. Webb, D. Mizuno, and T. Kuchar, "Preliminary Three dimensional CME Mass and Energy Using Solar Mass Ejection Imager (SMEI) Data"
- Johnston, J.C., D.R. Mizuno, D.F. Webb, T.A. Kuchar, and T.A. Howard, "Tracking Coronal Mass Ejections with a Heliospheric Imager: Case Studies from the Solar Mass Ejection Imager"

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Webb, D., D. Mizuno, G. Simnett, T. Howard, B. Jackson, J. Johnston and J. Tappin, "CMEs Observed in the Heliosphere by SMEI"

Jackson, B.V., A. Buffington, P.P. Hick, Y. Yu, D.F. Webb, "The Pertinence of Three Dimensional Solar Mass Ejection Imager (SMEI) Solar Wind Analysis to Ulysses Observations"

Simnett, G., "CMEs Observed By SMEI Which Are Not Seen By LASCO"

Webb, D.F., B.V. Jackson and P.P. Hick, "Use of Coriolis SMEI Imaging Observations to Provide All-sky Context Observations for the STEREO Mission", STEREO/Solar-B Workshop, Turtle Bay, Oahu, HI, 15-18 November 2005.

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T A Howard, J C Johnston, D F Webb, "Coronal Mass Ejection Evolution in the Inner Heliosphere – Geometry and Speed", SH32A-04

G M Simnett, T A Howard, "Interplanetary Transient Events Seen by SMEI Which are not Observed by LASCO: Analysis and Interpretation", INVITED SH32A-05

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A J Penny, "Variable stars with the SMEI instrument", SH32A-07

T Kuchar, A Buffington, T Howard, C N Arge, D Webb, B V Jackson, P P Hick, "The Evolution of Comets in the Heliosphere as Observed by SMEI", SH32A-08

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POSTER SH33A-0394

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# Appendix B SMEI CME Summary List

Version 10 (May 2006)

Notes:

1. Confidence in CME ID or Quality of event: E(xcellent), V(ery Good), G(ood), P(oor), ?(? Event). 2: SMEI orbital time as estimated at the azimuth location of the event. 3: Azimuth is angle in deg. measured CCW from ecliptic north through east.

4. Morphological type. V-arcs & CO are concave-outward structures. Halo is implied only.

5. Angular distance from Sun; first observed to last observed. 6. The associations are incomplete; systematic surveys are pending. 7. JT: Tappin id.; Earthward: likely an Earth-directed CME

Comments <sup>7</sup>		Prob. 1 CME; brief.	JT Wide arcs maybe also to N.	Subtle	Sm. bright blob; particles	Fast arc, fades	Slow, maybe 2 events	Other diffuse mat.? Particles.	Loop then arc; EP assoc. JT - same feature??
Shock/ Storm Assoc? <sup>6</sup>								Sh-TH	
Surface Activity? <sup>6</sup>	157			9					EP
LASCO Assoc? <sup>6</sup>	s. *							Y-TH	2/18,0242
Elong. vs Time?/ Movie?		<b></b>	N	λ/	Ϋ́Υ	ΥΥ	λγ	XX	<b>X</b> X
Elonga- tion Range [deg.] <sup>5</sup>	30.2-	33.9		23.0-	38.6-	32.3	23.4-	32.6	39.8
Point P Speed [km/sec]		232		339		494	283	288	602
Angular Speed [deg/hr]		0.38		0.52		0.77	0.44	0.46	1.00
Type⁴		2 arcs	arcs	arc	plob	arc	(s)dool	arc	loop/arc
Peak Bright- ness [adu]		1.0		0.5	2.0	1.0	0.5	0.5	1.0
Angu- lar Span [deg.]		23.4		20.3	16.3	23.3	75.1	23.3	44.4
Azimuth Location [deg/dir] <sup>3</sup>		44.3/NE	3S/"	231/SW	30/NNE	105/ESE	3/96	280/WNW	330/NW
Dura- tion [hrs.]		10		12	8.50	4	13.5	80	12
First Obs. Time [UT] <sup>2</sup>		12:32	21:10	16:15	8:24	2:41	10:36	12:54	5:12
Conf		۵		۵.	۵	О.	O	Ф	>
Date	9	Feb.	Feb.	12 Feb.	13 Feb.	14 Feb.	16 Feb.	17 Feb.	19 Feb.
Year/	2003	4	42	43	44	45	47	48	90

Comments <sup>7</sup>	Nice, wide arcs; >70 deg. JT??	Faint	Very narrow; 1 or 2 CMEs?	Not a CME? Moon glare?	Faint arcs in Cam2, JT??	Sm. bright blob	Large loop complex: SE EPL	Faint arc ff. above	Maybe continuation of above		Nice Wide loop, moon interferes	om, and failit blob, feal?	Same but brighter E-W motion; noisy; Cam2		Concave-out structure	2nd event? Overlaps with above	Faint, dubious CME	Rising material	Faint arc develops to loop
IP Shock/ Storm Assoc? <sup>6</sup>																		Sh-TH	
Surface Activity? <sup>6</sup>	Back?					EP?	EPL:1800	<i>~</i>							Back?		8		
LASCO Assoc? <sup>6</sup>	2/18,0642					2/27,2108	2/28,1830	~							3/12,0154			?sev.	
Elong. vs Time?/ Movie?	2Y/Y	<b>X</b> / <b>X</b>	2Y/Y	ΝŽ	ΣN	λ/λ	XX	XX	7/7	XX	X/X	XX	ΣN		<b>X</b> X	λ/	Υ/Y	Ϋ́	2Y/Y
Elonga- tion Range [deg.] <sup>5</sup>	27.0-	30.1	33.7			26.2- 31.3	24.7- 45.0	26.1- 29.7	31.8- 37.9	21.8- 44.2	26.2- 31.0	19.2- 22.8		16.7	28.7	21.2- 30.2	37.2	34.1	21.6- 42.3 34.3-
Point P Speed [km/sec]	394;414	379	314;348			254	450	354	200	462;682	300	374			397	855	444	425	430;526
Angular Speed [deg/hr]	0.72;0.76	0.59	0.49;0.56			0.40	0.76	0.56	0.34	0.77;1.05	0.47	0.55			0.60	1.32	0.73	0.67	0.65;0.86
Type4	sev	dool	2 arcs		arcs	plob	sdool	arc	arc	loop	plob	qolq	arcs		Varc	arcs	6		loop
Peak Bright- ness [adu]	1.0;1.0	0.5	2.0;2.0			2.0	1.0	1.0	0.5	0.5-1.0	0.5	0.5			1.5	0.5	0.5	0.5	0.5
Angu- Iar Span [deg.]	16; 29	20.0	18; 25			10.3	62.6	62.6	13.5	97.0	5.4	4.9			20.1	31.3	11.2	54.4	44.6
Azimuth Location [deg/dir] <sup>3</sup>	358; 19	157/SSE	145,143		SSE	329/NW	130/SE	125/SE	112/ESE	85/E	335/NW	44/NE	III N	l constant	20/NNE	53/ENE	8/NNE	336/NW	350/N
Dura- tion [hrs.]	44	8.5	35			5	25	7	17.5	58	10	7		i	21	^	12	20	24
First Obs. Time [UT] <sup>2</sup>	2:00	6:38	4:42	12:48	(5)	19:12	21:53	6:04	2:08	16:10	14:06	8:54	0:27		10:24	20:29	2:18	19:01	23:16
Conf	>	۵	O	٥-	۵	O	ш	Ŋ	۵	O	۵	۵	۵	;	>	۵	c-	O	۵
Date	21 Feb.	Feb.	Feb.	24 Feb.	Feb.	1 Mar.	1 Mar.	3 Mar.	4 Mar.	4 Mar.	7 Mar.	Mar.	Mar.	13	Mar. 13	Mar.	Mar.	Mar.	Mar. 24
Year/ DOY	52	54	22	55	28	09	09	62	63	63	99	7	72	i	72	72	27	78	8

6 Comments <sup>7</sup>	Shuttering interferes	Small, only 4 diffs	Faint outflow	Wide arc thru Cam2; Ulysses evt	Slow arc	Trailing arc catches leading	Concave-out; EP assoc.	Small blob, fades	Short arc, fades; moon interferes	Faint + brighter arc;Cam2	Sev. arcs; Cam2	Sev. bright arcs; Cam3 Eng.	1 bright arc; Cam2	2 short arcs, one brighter	halo, mostly N, 3 parts; Earthward	Slow arc	Bright, fast, limb loop	Another bright, fast limb loop	Faint, slow loop, 2 parts	Short, faint arc, Cam2
Shock/ Storm Assoc? <sup>6</sup>	Sh; St- TH		Sh-TH				Sh-TH								Sh; St, 8+					
Surface Activity? <sup>6</sup>	EP? 1512		Back?				EP 0125						Back?		X1:X3 fla.	X1;halo	M9,0223			
LASCO Assoc?	3/25,1354		4/4,17:26	same?		4/18,1526	4/23,0127						5/11,2058		5/28,0028	5/29,0127	5/31,<0354	6/2,0040		
Elong. vs Time?/ Movie?	<i>\\</i>	<b>X</b> X	77	XX	λγ	2Y/Y	XX	77	77	Y/Y	XX	34/7	λ/λ	Υ/Y	2Y/Y	χγ	<b>∀</b> \	λγ	2Y/Y	474
Elonga- tion Range [deg.] <sup>5</sup>	19.9-	27.5	29.0-	86.8	55.1-70.7	91.9	47.1	34.7	28.0	53.8	72.5	64.6	37.8- 60.2	55.0	32.4-	59.0- 60.2	43.9	41.8 - 4.18	54.6	54.5
Point P Speed [km/sec]	428	432	362-374	100	197	128;299	621	337	481	391	194	291;334	301	504	758	324	1164	778	432;216	324
Angular Speed [deg/hr]	0.65	0.66	0.58	0.93	0.61	0.76;1.37	1.06	0.54	0.73	0.89	0.60	0.65;0.79	0.64	1.03	1.76	0.69	1.99	1.32	0.85;0.45	0.70
Type⁴	2 arcs	arc		arc	arc	2 arcs	Varc	plob	arc	2 loops	arcs	arcs	arcs	2 arcs	halo	arc	dool	dool	dool	arc
Peak Bright- ness [adu]	1.0	1.0	0.5	1.0	9.0	0.3	1.0	0.3	1.0	0.3	0.2	1.0	1.0	1.0	0.5	0.3	1.0	1.0	0.5	9.0
Angu- lar Span [deg.]	44.7	9.6	21.3	53.2	27.8	35.4	49.8	10.4	37.9	21.8	23.4	30; 20;	48.0	17.1	89.1	25.0	61.9	47.1	54.2	22.3
Azimuth Location [deg/dir]³	341/NNW	342/NNW	293/NNW	71/ENE	15/NNE	13/NNE	330/NW	311/NW	290/WNW	38/NE	358/N	25;26;342 NE-NW	17/NNE	N/4	284/WNW	355/N	248/WSW	240/SW	13; 350	N/6
Dura- tion [hrs.]	13.5	6.5	*	12	25	30.5	20	15.5	8.5	3.5	36	24	48	15	24	27	8.5	-	24;22	11.5
First Obs. Time [UT] <sup>2</sup>	13:33	18:20	17:20	16:40	0:05	11:21	5:02	13:07	80.6	6:59	2:33	8:39	4:36	19:32	16:53	18:18	16:31	15:56	20:31	22:26
Conf	Ø	۵	O	>	Ø	>	>	۵	۵	O	>	>	>	O	ш	Ø	ш	Ø	ტ	۵
Date	26 Mar.	Mar.	6 Apr.	7 Apr.	4 Apr.	Apr. 25	Apr. 26	Apr. 28	Apr. 29	Apr.	3 May.	5 May.	May.	May.	28 May.	May.	May.	2 Jun.	3 Jun.	8 Jun.
Year/ DOY	85	98	96	26	108	110	115	116	118	119	123	125	133	140	148	150	151	153	154	159

Comments <sup>7</sup>	Very bright, short loop Sev. arcs in Cam3 + 2		Broad limb event.	Bright, but brief; particles	~3 long arcs; prob. 1 event	Faint, slow arc; poor data	Nice, mult. events, maybe 3	Wide (80deg!), bright arc	Same arcs(?) in Cam2+3	Faint, short arc in Cam2	Wide arc in Cam2; cal mode	Wide arc in Cam3+2; cal	Slow, faint arc	Slow, bent arc thru Cam3+2		Fast, wide arc, Cam2	Wide arc to 135 deg.	Faint, wide, fast arc thru Cam2	2 slow, wide arcs in Cam2	faint, short arc, Cam2	Short arc fades in Cam2	Wide arc ff. arc at edge Cam3 Faint sm. Loops; missing orbits
IP Shock/ Storm Assoc? <sup>6</sup>	Sh; St-	표																				
Surface Activity? <sup>6</sup>														1								
LASCO Assoc?																						
Elong. vs Time?/ Movie?	λ/λ	2Y/Y	ΥΥ	XX	X/X	٨/٨	2Y/Y		2Y/Y	XX	XX	7/7	XX	2Y/Y		2Y/Y		2Y/Y	λ/λ	XX	XIX	ΣZ
Elonga- tion Range [deg.]	26.1-	72.9	24.5-	34.4- 37.8	38.3-	68.8	64.1	47.0	42.0	57.7	43.5	58.2-	33.5	25.5- 71.9	42.0-	78.1	110-129	121	59.8	60.9	57.5	56.5
Point P Speed [km/sec]	715	489;562	804	306	456	182	411	372	518;378	520	792	336	505	437-336		1222	XX	123;xxx	292	237	256	452
Angular Speed [deg/hr]	1.12	0.94;1.16	1.30	0.53	1.23	0.53	0.94	0.65	0.91;0.59	1.14	1.43	1.08	0.80	0.91- 1.02		3.38	1.80	4.89;3.42	1.23	0.56	0.59	1.02
Type⁴	dool	arcs	dool	arc	arcs	arc	arc	arc	arc	arc	arc	arc	arc	Varc		arc	arc	arc	2 arcs	arc	arc	arc loops
Peak Bright- ness [adu]	5.0	0.5	1.0	1.5	0.5	0.2	0.5	0.7	0.5	0.5	0.5	0.5	1.0	1.0				0.4	0.5	0.3	0.3	4.0
Angu- lar Span [deg.]	39.9	36.6	73.4	15.6	24.0	23.3	30.2	48.1	25;15	19.2	54.0	19.1	37.9	47;40		73.8	73.8	85;33	32.5	19.0	23.8	36.6
Azimuth Location [deg/dir] <sup>3</sup>	305/NW	325;319	260/WSW	31/NNE	354/N	345/NNW	357/N	310/WNW	332/242	351/N	323/NW	N/00	298/WNW	305/NW		6.5/N	88/E	290;231	350/NNW	330/NW	324/NW	330/NW NW
Dura- tion [hrs.]	3.5	39	10	7	32	27	25.5	27	8.5	12	2	12	10	2+d.		10	10	22.5	15	24	13.5	8.5
First Obs. Time [UT] <sup>2</sup>	0:45	10:36	11:10	22:43	12:04	6:05	6:16	4:43	14:15	20:35	2:32	20:44	20:57	17:14		23:53	6:37	17:01	5:48	10:17	7:13	18:45
Conf	ш	>	Ø	۵	ш	O	Ш	ш	Ø	۵	Ø	>	۵	ш		ш	ш	ш	>	۵	۵	> ~
Date	13 Jun.	74 Jun.	24 Jun.	24 Jun.	26 Jun.	5 Jul.	10 Jul.		12 Jul.	19 Jul.	23 Jul.	24 Jul.	24 Jul.	25 Jul.		25 Jul.	26 Jul.	26 Jul.	29 Jul.	2 Aug.	5 Aug.	6 Aug. 7 Aug.
Year/ DOY	164	165	175	175	177	186	191		193	200	204	205	205	206		206	207	207	210	214	217	218

Comments <sup>7</sup>	Short arc; particles	Faint loop off limb	Short arc	Slow, wide arc in Cam2	2 faint loops in Cam3	Mult. loop struc.		Loop in Cam3, fades fast	Faint arc bet. particles. Real?	2 arcs, fade;halo? 2 assoc.EPs	2 NW arcs in Cam3	Wide arc in Cam2; see next	Wide arc in Cam2 to 135deg.	Large loop cmpl; fades fast	2 arcs of halo, Cam3	Bowed arc after anomaly; halo?	Bright, fast loop ff. by next	Faint, slower loop Loop to S, w/NW loop?; halo?	1 or 2 broad arcs, Cam2	Bright arc, extends to ENE	Wide arc(s) parts; not halo?
Shock/ Storm Assoc? <sup>6</sup>	Sh; St- TH									Sh; St 7			*	2	92,73,	9 .00,	Sh; St-			Sh; St-	?11/20, 9
Surface Activity? <sup>6</sup>										M4;M2		X5.4		X	X17,EP	X10,2049					
LASCO Assoc? <sup>6</sup>									10/18,2230	10/22,08;10		10/23,0854		10/26,1754	10/28,1054	10/29,2054	۲۶	\ \ \			11/18,0950
Elong. vs Time?/ Movie?	7/7	XX	XX	٨/٨	λ/λ	X/X	Χ/X	X/X	λ/λ	2Y/Y	2Y/Y	XX	<u></u>	λ/λ	2Y/Y	Y/Y	2Y/Y	×	2Y/Y	Υ/Y	X/X
Elonga- tion Range [deg.] <sup>s</sup>	54.0-	40.5	23.5-	65.7	31.3	28.8	28.3	22.9	36.4	40.4	45.0	70.8- 106	112	37.8	7.44	49.1	32.8	25.1- 37.7	68.8- 91.5	31.9	50.0- 73.5
Point P Speed [km/sec]	331	632	433	271	465	655	313	518	430	668;704	537,483	51	××	703	1611;1054	856	1322	540	279;172	836	775
Angular Speed [deg/hr]	0.82	1.08	0.67	0.71	0.73	1.00	0.48	0.77	0.71	1.15;1.14	0.95;0.88	3.37	4.22	1.13	2.57;1.86	1.71	2.04	0.88	3.31;1.27	1.31	2.34
Type <sup>4</sup>	arc	dool	arc	arc	2 loops	sdool	dool	dool	arc	2 arcs	2 arcs	arc	arc	sdool	2 arcs	arc	loop	d000	2 arcs	arc	arcs
Peak Bright- ness [adu]	0.3	0.3	1.0	0.5	0.5	0.5	0.5	0.03		1.0;2.0	1.0	0.5	0.5	0.9	1.0	1.0	2.0	2.0	0.5	1.0	0.5
Angu- lar Span [deg.]	18.1	72.8(?)	23.6	37.0	58.1	43.7	67.2	55.8	10.5	28;31	22.3	107.3	78.9	95.4	37.1	28.5	50.9	6.03	43;28	23.0	33.5
Azimuth Location [deg/dir] <sup>3</sup>	52/NE	268/W	294/NW	340/NNW	269/W	252/SW	268/W	276/W	108/ESE	328;190	326;332	101/ESE	294/NW	275/W	297;115	324/NW	267W	300/NW	142;89	129/SE	150/SSE
Dura- tion [hrs.]	2	8.5	9.5	24	10	7	13.5	9	10	7	13.5	10	7	15.5	7;6	÷	8.5	13.5	21	7	10
First Obs. Time [UT]²	5:04	19:54	11:03	20:44	5:53	10:51	9:59	0:41	4:30	11:37	4:33	6:52	16:08	6:49	13:03	5:27	21:54	8:04 <13:09	4:17	5:11	5:48
Conf	۵	۵	۵	O	۵	O	O	۵	۵	O	>	>	>	>	>	۵	>	> ७	O	O	ш
Date	Aug.	Aug.	21 Aug.	Aug.	2 Sep.	8 Sep.	Sep.	Sep.	Oct.	Oct.	0 ct.	0ct.	24 Oct.	Oct.	Oct.	Oct.	2 Nov.	3 Nov.	7 Nov.	Nov.	Nov.
Year/ DOY	229	232	233	240	245	251	260	264	293	296	297	297	297	300	301	304	306	307	311	318	323

Comments <sup>7</sup>	Broad arc sweeps thru Cam2,1	Likely <b>Earthward</b> Short, bright arc; particles	Bright arc thru Cam3. Nice.		Faint arc in Cam3+2	Bright, wide loop;parts., Venus	Bright, fast loop w/blob	Faint, broad arc in Cam2	2 sm. arc/blobs in Cam3	Sev, bowed arcs ff, by aur.	h,t: above CME in Cam2?	Loop ff. by 2nd?	Bod data . A cotation	Small are fodos	Faint slow ard: real? Good h t	1 slow wide arc? Cam3 to 2	Front+struc. loops; EIT EPL
IP Shock/ Storm Assoc? <sup>6</sup>	?same?	25				ć	Jo. Jo.		÷.	TH TH	č	Sh; St-					
Surface Activity? <sup>6</sup>			11/28,12:50										1	er E			EPL,0:
LASCO Assoc?		11/19,0950	11/28,??														2/15,0400
Elong. vs Time?/ Movie?	***	XX	$\lambda \lambda$		XX	XX	XIX	77	XX	XX	<del>\</del> \	7/7	<b>X</b> X	XX	ΥΥ	ΧX	XIX
Elonga- tion Range [deg.] <sup>5</sup>	65.5-	35.9	31.3		39.2-	43.0	31.1- 44.3	73.3-	21.0-	35.0-	67.8- 81.4	36.7	27.2-31.7	33.0	43.3-	102	21.9- 33.0
Point P Speed [km/sec]	XXX	615	433		324	714	1094	188	508	400	180	793	909	459	379	XXX	401
Angular Speed [deg/hr]	14.8?	1.01	0.68		0.71	1.19	1.92	2.50	0.77	0.71	0.98	1.26	0.81	0.72	0.77	1.25	0.63
Type <sup>4</sup>	arc?	arc	arc		arc	dool	loop	arc	qolq	arcs	arc	dool	plob	arc	arc	arc	Sdool
Peak Bright- ness [adu]	1.0	1.0	5.0		0.5	1.0	1.0	9.0	0.5	0.5	0.5	1.0	1.0	1.0	0.5	0.5	2.0
Angu- lar Span [deg.]	61.9	26.3	54.7		20.0	70.5	34.8	35.8	30.0	0.09	24.6	0.09	7.5	22.0	10.3	40;51	81.5
Azimuth Location [deg/dir] <sup>3</sup>	111/SE	324/NW	135/SE		141/SE	92/ESE	117/ESE	122/SE	115/ESE	133/SE	119/ESE	115/ESE	133/SE	145/SSE	58/NE	21-32	114/ESE
Dura- tion [hrs.]	+9	7	12		29	17	7	8.5	8.5	თ	13.5	12	5.5	Σ.	10	~36	17
First Obs. Time [UT] <sup>2</sup>	0:17	4:19	2:36	i cellino	6:40	6:04	0:23	9:06	8:11	3:48	22, 04:14	3:31	3:11	8:18	20:10	20:54	7:01
Conf	>	Ø	V 2:36	SIIIS III	۵	>	>	۵	Ø	>		Ø	۵	O	۵	Ø	ш
Date	21 Nov.	Nov.	Nov.	000	1 Jan.	3 Jan.	6 Jan.	Jan.	Jan.	Jan.	ç	Jan.	23 Jan.	Jan.	7 Feb.	9 Feb.	Feb.
Year/ DOY	325	325	334	2004	_	က	9	1	14	21		22	23	25	38	40	47

First year totals: 105 = 13E, 25V, 30G, 34P, 3?, 1 None. So, 68 = E, V or G.

Commonte?	0, ,		Series of arcs; 2 parts of halo?	Nice arc; brief: parts., mode chg.	JT- Cam3, messy, data gap	Very slow loop; nonradial, real?	Sm. fast, compact blob	Nice loop, but fades & shutter	Wide loop	Ft., wide arc in Cam2, aurora at	start; JT- Cam 2; auroral? Arc in Cam3; same as 18:56?	Slow, wide arc, Cam2:ff. d094 arc	JT- very faint.	Ft. wide arc in Cam2; particles	Faint, glare, real?		JI - stray light?	rt, wide arc in Camz, bet, parts. JT- wide arc hits CometNeat, Tail dis-	con.; likely near <b>Earth.</b> Ft. wide loop: IT. faint complex	and complex	Ft., wide, peaked loop;Cam3 to 2 JT- sm., faint: same as next?	
IP Shock/ Storm Assoc? <sup>6</sup>							; ;	JO, OF											Sh-TH			
Surface Activity?	•																					
LASCO Assoc? <sup>6</sup>																		5				
Elong. vs Time?/ Movie?	<u>&gt;</u>		77	*		XX	XX	XX	Ν	7/7	Υ/Y	λγ		XX	XX		\\ \	Ϋ́		×	Y/Y	
Elonga- tion Range [deg.] <sup>§</sup>	21.7-29.3		19.8- 93.3	22.0-		28.6-	34.1	33.8	81.1	9.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00	43.8	87.8		57.0- 67.5	43.8- 48.3		48.8-		50.4-	69.6	55.5	
Point P Speed [km/sec]	717		377	457		370	427	447		391	443	142		355	234		343		3	241	425	
Angular Speed [deg/hr]	1.10		0.98	0.70		0.61	0.68	0.71		2.56	0.76	1.19		1.06	0.47		0.89		Ç	0.00	0.92	
Type⁴	dool		arcs	arc		dool	plob	dool	loop	arc	arc	arc		arc	qolq		arc	arc	9	sdool	dool	
Peak Bright- ness [adu]	1.0		1; 2	1.0		0.5	1.0	1.0	1; 0.5	9.0	1.0	0.5		0.5	1.0		1.0		u C		9.0	
Angu- Iar Span [deg.]	38.4		65;25	35.3		44.0	10.7	49.0	85;38	54.8	0.09	49.8		33.5	3.3		30.1		76.2	4.04	86.5	
Azimuth Location [deg/dir] <sup>3</sup>	197/SSW	/SE	NNW/ESE	340/NW	MN/:	4/NNE	326/NW	3/NNW	N-NW-N	20/NE	357/NNW	44/NE	./NE	25/NNE	275/W	NE.	15/NNE	JSE	23/NE	1	356/N	/NNW/
Dura- tion [hrs.]	7		3 9	1		4	12	12.5	2	10	20	12		10	10		60	2.5d	70~	i	24	
First Obs. Time [UT] <sup>2</sup>	8:32	23:38	16:42	19:32	9:32	18:06	10:41	10:00	9:42	22:36	7:08	18:56	19:43	0:45	14:31	21:30	5:43	21:08	2.26	2	13:22	10:28
Conf	ŋ	۵	ш	O	۵	~	۵	O	O	ტ	O	O	۵	۵	<b>~</b>	<b>~</b>	۵	ტ	۵		O	
Date	21 Feb.	22 Feb.	8 Mar.	Mar.	18 Mar.	26 Mar.	Mar.	Mar.	1 Apr.	3 Apr.	4 Apr.	4 Apr.	Apr.	Apr	Apr.	27 Apr.	1 May.	4 May.	10 M	22	May. 23	May.
Year/ DOY	52	53	89	70	78	98	88	6	85	94	92	92	101	105	117	118	122	125	13	2	143	144

										. <u>.</u>										
	Ft., wide arc- Cam2		Brg, wide arc to Cam2 edge; be- comes concave-out; weird h,t	Follows prior evt.but less defined.	3, fades	art. bands	Loops Cam3 to 2; moon, parts.	s; Cam2	Brief in Cam3; Parts., shutter.	Wide loop to edge, Cam2; maybe mat. to SE Cam3. Earthward; storm;		Nice but brief due to particles			Cam2.	Brg. loop in Cam3;shutter early		Wide, fast arc, fades; SE to NE		ades, noisy
Comments7	Ft., wide arc- Cam2		Brg, wide arc t	Follows prior	Brg loop Cam3, fades	Ft. loop bet. part. bands	Loops Cam3 t	Series of loops; Cam2	Brief in Cam3	Wide loop to e	aurora at end	Nice but brief		Faint loop	Ft, slow arc in Cam2.	Brg. loop in C	(new meas.)]	Wide, fast arc	(new meas.)]	Ft, short arc; fades, noisy
IP Shock/ Storm Assoc? <sup>6</sup>								Sh-TH	기 기	same?		Sh-TH								
Surface Activity?	<b>.</b>		arcade,EP?							M9,1230					p					
LASCO Assoc? <sup>6</sup>			5/24,2126							7/20.1330 Part. Halo										
Elong. vs Time?/ Movie?	× ×	:	XX	XIX	\ \	XX	2Y/2Y	2Y/2Y	XIX	2Y/Y		λ/λ		X/X	XIX	Y/A	Y/F	Y/A	Y/F	Y/A
Elonga- tion Range [deg.] <sup>5</sup>	49.0-	) : )	46.5- 72.1	40.7-	23.3-	30.0	68.8	60.4	24.5	62.0	22.2-	35.8		22.4- 30.9	56.8	26.9	27.3	106	107	47.7
Point P Speed [km/sec]	, Oge	}	295	431	625	488	929	350	464	728;715		483		571	299	380	443	XXX	xxx	663
Angular Speed [deg/hr]	. 60		0.82	0.98	0.99	92.0	1.18	0.77	0.70	1.57;1.24		0.77	ن ق`	0.89	0.68	0.57	0.68	3.33	3.59	1.25
Tvpe4	, a	qold	Varc	arc	dool	dool	dool	sdool	arc	loop		dool	= E, V or G.	loop	arc	dool		arc		arc
Peak Bright- ness [adu]			1.0	1.0	5.0	1.0	÷-	0.3,0.5	1.0	0.5; 1		1.0	So 86 =	. 9.0	0.5	2.0	0.5	0.5	0.5	0.5
Angu- Iar Span Idea.]		3	47.6	34.8	51.3	19.3	48;35	30;11.5	25.1	113;110		39.9	32, 4 None	55.1	26.5	34.2	41.4	80.1	84.2	19.3
Azimuth Location Idea/dirl <sup>3</sup>	N/A78	NNE.	13/NNE	6-10/N	306/WNW	290/NW	292- 306/NW	330-341/	278/WNW	348;302		245/SW	15E, 28V, 43G, 43P, 6?, 4 None.	266/W	313/NW	266/W	267/W	89/E	92/E	123/SE
Dura- tion	15	ļ	27	24	10	~12	35	1.5d	Ŋ	50		. 17	15E, 28V	19	19	12	7	8.5	8.5	8.5
First Obs. Time	5 5	19:27	6:29	4:30	9:08	5:40	7:34	19:28	21:28	16:02		3:38	107 + 32 = 139.	8:46	23:24	8:34	12:39	13:11	11:26	5:15
,	5 0	7	>	O	O	۵	>	>	O	ш		Ø	: 107 + 3	۵	۵	۵		>		۵
	24 May	27 May.	28 May.	28 May.	23 Jun.	29 Jun.	10 Jul.	15 Jul.	20 Jul.	21 Jul.		29 Jul.	1.5 Year totals:	15 Aug.	17 Aug.	2 Sep.		13 Sep.		16 Sep.
Year	5 5	148	149	150	175	181	192	197	202	203		211	1.5 Ye	228	230	246	L	257	L	260

Comments <sup>7</sup>		Faint loop, Cam3	(new meas.)]	Broad, faint, subtle arc	Faint, short arc in Cam3	Noisy, real? Part of next halo?	Wide loop to 270d! Earthward, Cam2-1	2nd brighter, wide loop. Earthward	Arcs Cams3-2	3 related events? Bright arc in Cam. 2	Wide loop sweeps SE-Earthward.	Camz, dimming benind loop:	Faint, fairly wide loop in Cam2	Loop Cam 3 - 2 then fades	Bright, fast arc fades in Cam3	2 seq. bright arcs fade quickly		Brg. struct. In Cam3, faint in Cam2	Fades fast; cutoff to W by shutter	Prob. same evt., Cam3-2; PAs diffe	Fades in Cam3; maybe next in Cam
Shock/ Storm Assoc? <sup>6</sup>																					
Surface Activity? <sup>6</sup>											1							9			
LASCO Assoc? <sup>6</sup>																					
Elong. vs Time?/ Movie?	Y/F	Y/A	Y/F	Y/F	Y/F	Υ/F	Y/F	Y/F	2Y/F	2Y/F	Y/F	>	X.F.	Y/F	Y/F	2Y/F		Y/F	Y/F	3Y/F	Y/F
Elonga- tion Range [deg.] <sup>5</sup>	37.1-	34.4	32.3	63.6-	37.7- 41.4	36.6-	73.9-	78.2-	38.9- 86.0	37.4-	70.4-	75.3-	100	32.2-	20.9- 32.9	23.4-	į	71.4	30.4	77.6	38.0
Point P Speed [km/sec]	518	744	505	188	316	288	XX	XXX	252; 861	577; xxx	XX	66	S ×	280	636	618; 701		694	517	999: 200	580
Angular Speed [deg/hr]	0.94	1.17	0.79	0.74	0.57	0.54	1.09	2.61	1.68;	1.33; 1.83	2.31	200	0.95	1.42	0.99	1.15		1.46	0.80	1.00;	96.0
Type⁴		dool		arc	arc	dool	halo?	halo?	arcs	arc	dool	G	dool	dool	arc	2 arcs		arc	arc	arcs	dool
Peak Bright- ness [adu]	0.5	0.5	0.5	0.3	0.5	0.2	0.3	1.0	0.5	1.0	0.5	7	0.3	1.0	1.0	1.0		2.0	1.0	2.0	1.0
Angu- lar Span [deg.]	25.5	61.4	71.5	39.9	34.7	19.1	94.1	107.8	27.7	80.4	135.0	25.5	39.2	34.3	27.8	51.0		66.5	40.6	70.0	44.1
Azimuth Location [deg/dir] <sup>3</sup>	120/SE	270/W	270/W	333/NW	293/WNW	56/ENE	93/E	122/SE	313; 327	348/NNW	122/SE	EN/CA	119/SE	115/SE	103/ESE	98; 110		116/ESE	120/SE	123; 140	97/ESE
Dura- tion [hrs.]	7	~20	12	15.5	7	20.5	25.5	10+	7	29	17	5	24 5	32	12	6.5		32	10	~39	10
First Obs. Time [UT] <sup>2</sup>	5:19	8:24	15:09	18:31	14:38	16:33	11:08	2:17	19:22	6:02	6:02	ć	21:49	7:53	10:03	6:23		2:22	10:14	14:44	3:24
Conf		۵		O	۵	<b>~</b>	ш	ш	ტ	ш	ш	0	_ თ	>	O	O		>	۵	>	O
Date		Sep.		13 Oct.	1 Nov.	4 Nov.	5 Nov.	6 Nov.	8 Nov.	4 Dec.	4 Dec.		19 19 Dec.	26 Dec.	30 Dec.	31 Dec.		2 Jan.	4 Jan.	6 Jan.	Jan.
Year/ DOY	_	. 264		287	306	309	310	311	313	339	338	C	35, 436	361	365	366	2005	8	4 1	φ	10

Year/ DOY	Date	Conf	First Obs. Time [UT] <sup>2</sup>	Dura- tion [hrs.]	Azimuth Location [deg/dir] <sup>3</sup>	Angu- Iar Span [deg.]	Peak Bright- ness [adu]	Type⁴	Angular Speed [deg/hr]	Point P Speed [km/sec]	Elonga- tion Range [deg.] <sup>5</sup>	Elong. vs Time?/ Movie?	LASCO Assoc? <sup>6</sup>	Surface Activity? <sup>6</sup>	IP Shock/ Storm Assoc? <sup>6</sup> (	Comments <sup>7</sup>
12	12 Jan.	٥-	18:14	4	112/SE	6.	0.3	qolq	0.82	249	59.6- 70.3	Y/F			Ж ө	Real? Cam2; Moon in Cam3
16	Jan.	ш	13:44	~37	79; 118	68.4	2.0	arc(CO)	1.39; 1.8	776; ~500	81.5	3Y/F			2?Ar First 17th	2?Arcs in E&SE,Cam3; then into C First is C.O.; Earthward-aurora on 17th
17	17 Jan.	Ø	22:37	7	319/NW	40.1	1.0	dold	2.81	1342	39.2- 57.7	Y/F			Ę.	Fast arc to NW, Cam3
19	19 Jan.	۵	23:36	25	318; 331	45.6	0.5	qolq	2.52	1137;1280	53.4 53.4	2Y/F			Blo	Blob fades fast; h,t's differ 2nd event is famous SEP
12	21 Jan.	O	12:52	10	323/NW	36.6	1.0	arc	1.88	954	35.2- 54.4	Y/F			Arc	Arc in Cam3; aurora late on 21st
24	Jan.	۵	9:35	20.5	129/SE	30.5	0.3	arc	0.76	224	73.5	Y/F			Slo	Slow arc in Cam2; subtle
27	27 Jan.	<i>c</i> -	6:48		8/			arc			Ì	N/N			Sic	Slow arc in Cam2; (no h,t; movie)
28	Jan.	۵	4:50	Ω	187/S	24.4	0.3	arc	2.59	XXX	90.5	XX			Fa	Faint arc to S Cam2; poss. part ES
28	28 Jan.	ш	18:32	5	150/SE	75.5	0.3	dool	2.52	XXX	77.4- 116	<i>\</i> .\			CA	Wide, fast loop appears at 80E in Cam2-1; asymmetric; Earthward?
30	30 Jan.	۵	5:03	25.5	3.5/N	67.4	0.3	loop	0.71	XXX	87.0- 108 38.5-	Υ/Υ			Wic	Wide asy. loop; particles; 2 h,ťs?
31	Jan.	۵	10:30	8.5	68/NE	14.4	0.5	arc	0.82	439	45.4	Y/Y			Shc	Short arc in Cam3; parts. obscure
32	1 Feb.	g	0:42	_	130/SE	27.1	1.0	dool	1.12	689	35.4 86.4	٨/٨			Ber	Bent arc in Cam3; subtle; comet ta
35	4 Feb.	>	2:59	15	125/SE	21.4	9.0	arc	1.58	232	89.6	Υ/Y			Nar	Narrow, thin arc in Cam2
47	Feb.	Ø	8:32	12	353/N	40.0	9.0	Varc	1.54	XXX	91.8	٨/٨			Wic	Wide, slightly C.O.arc in Cam2
48	Feb.	۵	13:32	7	313/NW	8.2	0.5	qolq	3.47	XXX	95.1	X/X			T.a.	Faint, fast blob in Cam2
54	Feb.	~ O	10:46	>3 d? 22	332/NW	38.7	0.5	arc	0.69	398	29.4-	N			H,t	raint, wide arc Cam3-2;(no H,t;movie)
62	3 Mar.	۵	20:51		13/NNE	18.2	0.5	arc	1.01	636	24.8 24.9-	XX			Cle	Clear loop in Cam3; ends in parts.
63	4 Mar.	>	22:19	25	33/NNE	46.1	9.0	arc	1.02	XXX	78.6- 105				N N	oriori, idilit arc in Carno, subue Wide, asy. arc, Cam2; parts., need C1
11	Apr.	۵.	20:03	27	26; 21	31.9	0.3	arc	0.85	192; 276		27/7			Fail	Faint, slow arc in Cam2; C3 shuttered
162	Jun.	۵	4:13	7	100/E	37.5	0.5	arc	1.79	153	77.0- 89.2	λ/Y			Fair N	Faint, wide, asy.arc in Cam2;also ii N

	;ahead of ne	2	e interferes e Cam2;	Earthward?	iterfere	rrora late Jul	few orbits	i, Earthward?	ve aur. at star	am3;shutter E	n2; 2nd N arc	Earthward? before next	Sam2		n2	W	rames); Cam2	are interferes	12; earlier fast rthward?
Comments <sup>7</sup>	Short arc to NW Cam2;ahead of nex	Brg, wide loop, Cam3-2	Faint arc in Cam2; glare interferes Clear asy. loop to edge Cam2;	aurora on 23rd; faint N part? Earthward?	Sev. faint arcs; parts. Interfere	Sev. brg. arcs; poss. aurora late Jul '	Wide arc to SE; only a few orbits	Faint; aurora early 10th; Earthward?	Wide arc in Cam2; above aur. at star	2 brg. loops to edge Cam3;shutter E	Wide loop NW thru Cam2; 2nd N arc	trails; aurora mid-17th; Earthward? Curved loop in Cam2; before next evt.	Nice loop but fades in Cam2	Faint NW arc in Cam2	Faint, ~C.O. 'arc' in Cam2	Very faint arc(s) E & NE	Wide, subtle, fades (4 frames); Cam2	Very faint arc; real?; glare interferes	Broad, fast loop E Cam2; earlier fast arc to NW? Aurora; Earthward?
Shock/ Storm Assoc? <sup>6</sup> (	0)	) ( ) ( ) ( ) ( ) ( ) ( ) ( ) ( ) ( ) (			co.	o	>		^	2	>	0 0 4	2	ш	ш	>	>		ш <i>а</i>
Surface Activity? <sup>6</sup>																			
LASCO Assoc? <sup>6</sup>																			
Elong. vs Time?/ Movie?	Υ/Y	2Y/Y	Υ/Υ	Y/2Y	XX	Υ/Y	XX	\\ \	XX	2Y/Y	2Y/Y	*	χ×	λ/λ	λ/λ	XX	XX	λγ	***
Elonga- tion Range [deg.] <sup>5</sup>	46.3- 54.4	54.0	84.2- 84.6	124	58.8 58.8	32.8- 45.6	87.3 <b>-</b> 103	49.1- 64.9	27.6- 70.8	19.1- 36.0	50.8- 94.0	57.3- 68.2	95.9	77.9	57.6- 69.9	91.7	104-113	6.1.6 9.1.6	
Point P Speed [km/sec]	724	153; 724	184	XXX	438	969	XXX	730	1099	742; 900	xxx; 806	489	XX	562	328	XX	XXX	141	×
Angular Speed [deg/hr]	1.57	1.79;	96.0	1.89	66.0	1.06	1.80	1.87	2.30	1.14	2.61; 2.26	1.48	1.58	1.57	1.03	0.86	1.05	0.94	5.63
Type4	arc	dool	arc	dool	arcs	arcs	arc	diffuse	arc	2loops	2 arcs	dool	dool	arc	arc(CO)	2 arcs	arc	arc	dool
Peak Bright- ness [adu]	0.5	0.5;1.0	0.5	0.5	XXX	XX	0.5	XXX	0.5	XXX	0.5	0.3	0.5	0.3	0.5	0.3	0.3	0.2	0.5
Angu- lar Span [deg.]	22.8	81.9	26.6	53.3	XXX	×	33.1	XX	57.6	XX	74.5	28.3	31.5	0.09	43.1	15.9	40.9	21.7	66.5
Azimuth Location [deg/dir] <sup>3</sup>	320/NW	282; 342	51/NE	110/E	17/NNE	355/N	128/SE	338/NNW	305/NW	287; 281	266; 0.0	38/NNE	100/E	325/NW	297/NW	105/E	155/SSE	82/ENE	36/E
Dura- tion [hrs.]	4	23	20	15	13.5	12	8.5	8.5	9	24	15	7	13.5	22	12	15	~8.5	7.5	ıΩ
First Obs. Time [UT] <sup>2</sup>	14:54	18:41	15:07	17:55	17:33	20:38	23:40	21:23	12:37	21:54	12:33	12:08	16:56	2:27	15:28	9:31	7:00	10:25	18:16
Conf	ტ	>	۵	>	Ø	>	Ŋ	۵	O	۵	>	O	>	۵	۵	۵	۵	~	>
Date	15 Jun.	Jun.	Jun. 20	Jun.	29 Jun.	Jun.	7 Jul.	9 Jul.	10 Jul.	13 Jul.	16 Jul.	31 Jul.	31 Jul.	5 Aug.	Aug.	Aug.	Aug.	Aug. 24	Aug.
Year/ DOY	166	166	171	173	180	181	188	190	191	194	197	212	212	217	225	231	233	234	236

Comments <sup>7</sup>	Very faint, short arc in Cam2	Wide, fast loop in Cam2; aur. strean er & shock 9th; Earthward? AR808	SE arc in Cam3; maybe in Cam2; X fl. bro air & shock 11th. Farthward
Shock/ Storm Assoc? <sup>6</sup>	Ť.		
Surface Activity? <sup>6</sup>			
LASCO Assoc? <sup>6</sup>			
Elong. vs Time?/ Movie?	XX	Υ/Υ	λγ
Elonga- tion Range [deg.] <sup>5</sup>	75.4- 83.9	94.9	37.0- 49.5
Point P Speed [km/sec]	156	XX	777
Angular Speed [deg/hr]	1.22	2.26	1.49
Type⁴	arc	dool	arc
Peak Bright- ness [adu]	0.2	0.5	1.0
Angu- lar Span [deg.]	14.7	45.1	26.1
Azimuth Location [deg/dir] <sup>3</sup>	77/ENE	84/ENE	119/SE
Dura- tion [hrs.]	7	7	7.5
First Obs. Time [UT] <sup>2</sup>	4:40	22:21	13:06
Conf	۵	O	۵
Date	29 Aug.	8 Sep.	10 Sep.
Year/ DOY	241	251	253

SMEI Camera Configuration Log: 2003

Notes:

Times are for beginning of pass in which event occurred, exact time of execution may be up to 15 mins later.

Blue fort denotes planned activities.

Red fort denotes problems, a normalies.

Green fort denotes WindSat activity.

Magenta fort denotes a Spacecraft anomaly.

Orange font denotes CCD annealing.

				naly	+30/		SONFIG	ording	SONFIG	ording					ording				I								T	T	I					T		T	T			T
	Comments	DHU pwr'd ON	Delcers set to +30 / +30 /+30	SMEI to SAFE due to ACS anomaly	DHU pwr'd ON, Delcers to +30 / +30 / +30		Cam 1 anomaly, put SMEI into CONFIG mode	Turned Cam 1 OFF, stopped recording	Cam 1 anomaly, put SMEI into CONFIG mode	Turned Cam 1 OFF, stopped recording	DHU reset fixed anomaly				Turned Cam 2 OFF, stopped recording			The second second											Opened Cam 1 Door	Opened Cam 2 Door	Opened Cam 3 Door				N of accordate actif	99% of complete orbit				<1 orbit-ok, shtr closed
Н	Obs Duration (DD:HH:M M)	픕	De	SM	五点	01:28	no obs mo	Tu	no obs mo	Τ	02:33 DH	02:10	01:39	01:34	μ	01:47	02:03	-	02:05	91:10	47.07	01.20	01:41	02:06	21:36	01:34	01:48	16.30	$\top$			03:13	01:40	01:39	02:11	+	01:39	01:46	$\overline{}$	01:28
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	Time (Zulu)	7:17	8:51	8:49	10:52	22:36	0:04	0.45	7:04	8:37	1:30	4:03	6:13	7:52	9:26	15:53	17:40	19:43	17:57	20:02	21:18	16.10	17.39	19:20	21:26	19:02	20:36	22.24	16.35	18:25	20:05	21:28	0:41	2:21	4:00	6.11	0.30	11:18	13:04	14:42
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L	Rev # or	11.0	12.0	42.0	43.2	80.1	81.0	7 7	85.3	88	96	98.0	99	100.3	101.2	105.1	106	107.4	234	235	236.1	237.1	248	249	250	263	264	265	375.1	376	377	392	394.0	395	396	397	398.2	400.3	401.3	402.3

> 1 orbit by time		<1 orbit—ok, shtr closed <1 orbit—ok, shtr closed					> 1 orbit by time							Deicers set to -30 / -3- / -2; Fast TC set	Went to SAFE, recovered from SAFE		Deicers to -30 / -30 / +3		Delcers to -30 / -30 / -30, Torced delce on Cam 3							Delcers to -40 / -40 / -3	Dolone to 38 ( 33 / 2)	Delcers to -38 / -32 / -2		includes SAA orbits		Delcers to -38 / -32 / +2 includes SAA	Delcers to -38 / -32 / +5		Delcers to -38 / -30 / -2		Delcers to -38 / -20 / -2; includes SAA	Delcers to -38 / -10 / -2		includes SAA orbits		Manager As dead Didney Manager	includes SAA			WindSat +45 deg Pitch Maneuver	Delcers to -38 / -27 / -2; incudes SAA		includes SAA		Anomaly occurred-no images
	02:07	01.30	01:41	01:38	02:12	01:40	01.30	0.00	01:43	03:27	01:45	01:46	01:19	01:25	01:40	03:49	11:35	06:37	19:17:11	02:00:00	02:00:00	02:00:00	13:04:00	00:02:00	03:22:00	00:01:40	02.71.20	00:01:40	05:17:20	00:09:10	00:01:40	00:00:00	00:03:20	00:09:10	00:01:40	00:03:20	00:07:40	00:03:20	00:01:40	00:07:70	02:00:00		00-07-40	00:03:20	00:01:40		00:09:10	00:01:40	00:09:10	04:16:20	04:20:20
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12-Jun-03	12-Jun-03	13-Jun-03	13-Jun-03	14-11n-03	20-Jun-03	20-Jun-03	20-Jun-03	20-Jun-03	21-Jun-03	21-Jun-03	21-Jun-03	28-Jun-03	30-Jun-03	2-111-03	3-101-03	4-111-03	4-Jul-03	4-Jul-03	4-Jul-03	4-Jul-03	5-Jul-03	5-Jul-03	8-Jul-03	9-Jul-03	9-Jul-03	11-11-03	11-14-03	11-Jul-03	11-Jul-03	12-Jul-03	12-Jul-03	12-Jul-03	13-Jul-03	14-Jul-03	10 111 03	23-Jul-03	23-Jul-03	23-Jul-03	23-Jul-03	24-Jul-03	24-301-03	1-Aug-03	1-Aug-03	1-Aug-03	1-Aug-03	1-Aug-03	1-Aug-03	2-Aug-03	2-Aug-03	2-Aug-03	4-Aug-03	6-Aug-03	8-Aug-03	8-Aug-03
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Delcers to -3/-3/-3, includes SAA orbits		C3 ANNEAL, normal thrm ctrl set	fast therm ctrl, Delcers to -50 / -50 / -3, SAA orbits	Delcers to -50 / -50 / -50	anomalyno images	anomaly-no images	anomaly-no images	anomalyno images	Code Load: Patch Upload, part 1	Code Load: Patch Upload, part 2, Patch Activate (anomaly resolved)	Code Load: Fast TTC, Delcers to -50/-	50/-50, Norm Obs mode				Hot Anneal, part 1: C3 Delcer at 50% duty cycle: Norm TC	Hot Anneal, part 2 C3 Deloer at 25%	duty cycle Fast TC	Hot Anneal, part 2a: C3 Delcer at 75% duty cycle; Norm TC>INVALID TELEM ANOMAI V			Fast TC	Hot Anneal, part 2a (repeated because of anomaly): C3 Defeer at 75% duty cycle; Norm TC->NOT EXECUTED due to RSC operator error	Fast TC>NOT EXECUTED due to RSC operator error		Delcers to -50 / -50 / -3	Hot Anneal, part 3: C3 Deloer at 87% duty cycle, Norm TC	Fast TC, Delcers to -50 / -50 / -50		Delcers to -50 / -50 / -50	Delcers to -30 /-30 / -3	anomaly-no images	DHU reset (code ver: 1)	Delcers to -30 / -30 / -1	Delcers to -50 / -50 / -50				Delcers to -30 / -30 / -1				soft reset			soft reset
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DHU reset - temp monitor anomaly (code ver. 2)	$\rightarrow$	soft reset	_	son reset			soft reset	soft reset	soft reset	soft reset	soft reset	DHU reset - partially invalid data "anomaly" (code ver 3)	to the					soft reset							to the second				soft reset	Anomaly: C2 shutter mis-labelled as CLOSED	soft reset; anomaly resolved	soft reset		Cams 2 & 1 show same anomalous symptom as Cam 3	DHU reset attempted, SMEI unresponsive to GOTO, CONF and	OHI Bosot (code ver 4)	soft reset	soft reset, after this automatic soft resets implemented	ACS anomaly, SV to Safe Hold, ACS to B- dot, WindSat despun (controlled), SMEI mode unchanged		to reset non-std config after auto soft	_			routine soft reset	includes SAA orbits			Inadvertent Reboot-SEU? (code ver. 5)	m s	still valid
	00:11:15	00:12:15	24.40	00.01.45	00:01:45	00:90:00	00:14:15	00:11:15	00:12:45	00:11:15	00:12:10	00-00-35	2000	00.12.45	00-11-15	00-12-45	00-11-15	00-12-45	00-11-15	00-12-45	20.00	00.00	24.10.00	25.10.00	00:00:00	00:12:45	61:11:00	00:12:45	00:11:15		00:12:45	00:11:15	01:06:44			00.08.04	00.00.01	01-23-30		00:00:32	0000	00.01.13	00.01.45	00:08:00	02:16:45	00:07:30	00:01:45	03:08:15	00:01:00	05:21:15	00:02:47
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20-Nov-03	20-Nov-03	21-Nov-03	21-Nov-03	21-Nov-03	22-Nov-03	22-Nov-03	22-Nov-03	22-Nov-03	23-Nov-03	23-Nov-03	24-Nov-03	Mov. 03	20-A0A-02	24-Nov-03	SO-VON-CS	26-Nov-03	SO NOW SO	27 Nov. 03	27 Mov. 03	20 NOV 03	20-NON-02	28-Nov-03	29-Nov-03	29-Nov-03	29-Nov-03	29-Nov-03	29-Nov-03	30-Nov-03	30-Nov-03	30-Nov-03	1-Dec-03	1-Dec-03	2-Dec-03	2-Dec-03	2000	3-Dec-03	3-Dec-03	3-Dec-03		8-Dec-03		6-Dec-03	6-Dec-03	6-Dec-03	6-Dec-03	9-Dec-03	10-Dec-03	10-Dec-03	13-Dec-03	13-Dec-03	19-Dec-03
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07754880	19-Dec-03	353	17:40	4	4X4	Ö	o N	OPEN	OFF	-50	4	4X4	4X4 ON ON		OPEN	OFF	-50	3YN002	2x2	NO	OFF	DYN002 2x2 ON OFF OPEN OFF	OFF	-50	00:22:35	00:22:35 DHU Reset (code ver. 6)
07768944	20-Dec-03	354	16:15	-	L					-50	-							000NAC	1X1	OFF	OFF (	DYN000 1X1 OFF OFF CLOSED OFF	OFF	Н	00:01:45	
0778A1E0	20-Dec-03	354	18:00	-						-50	DYN000	1X1	OFF	OFF C	OFF OFF CLOSED	OFF	-50	,						_	00:05:47 ir	includes SAA orbits
0776F334	20-Dec-03	354	23:47	-						-50	DYN000	1X1	OFF	OFF C	DYN000 1X1 OFF OFF CLOSED OFF		-50	1						-50	00:00:13 Soft reset	Soft reset
0776F640	21-Dec-03	355	00:00	DYN000 1X1	1X1	OFF		OFF CLOSED	OFF	-50	-		2000000		-	- Allerton	-50	1						-20	00:01:45	
07770EDC	21-Dec-03	355	1:45	4	4X4	4X4 ON	NO	OPEN	OFF	-50	4	4X4	NO	NO	OPEN	OFF	-20	DYN002	2x2	NO	OFF	OPEN	OFF	-20	01:14:30	
07792C44	22-Dec-03	356	16:15	-	L	L	L			-30	-						-28 E	DYN001 1X1 ON OFF	1X1	NO		OPEN	OFF	2	02:00:00 E	02:00:00   Delcers to -30 / -28 / +2
077BCF44	24-Dec-03	358	16:15	-	L	L				-30	DYN001 1X1	1X1	N O	OFF	OPEN	OFF	-28	-		Γ	r			2	02:00:00	
077C3934	24-Dec-03	358	23:47	-						-30	DYN001 1X1	1X1	NO	OFF	OPEN		-28	1		3				2	00:11:15 Soft reset	Soft reset
077CD768	25-Dec-03	359	11:02	-	L	L				-30	DYN001 1X1	1X	ON OFF		OPEN	OFF	-28	1						2	00:12:45 Soft reset	Soft reset
077D8AB4	25-Dec-03	359	23:47	-	L	L				-30	-30 DYN001 1X1 ON OFF	1X1	S O		OPEN	OFF	-28	-			T			2	00:11:15 Soft reset	Soft reset
077E28E8	26-Dec-03	360	11:02	-	L					-30	-30 DYN001 1X1 ON OFF OPEN OFF	1X1	NO.	OFF	OPEN		-28	1						2	00:05:13 Soft reset	Soft reset
Г	26-Dec-03		16:15	-	L	L			Ĺ	99	DYN000 1X1 OFF OFF CLOSED OFF	1X1	OFF	OFF	COSED .	_	-27	-						ç	00:01:45 L	00:01:45 Delcers to -30 / -27 / -3
Т	26-Dec-03	360	18:00	-						-30	-						-27	ONAC	171	OFF	OFF	DYN000 1X1 OFF OFF CLOSED OFF	OFF	ę	00:06:15	00:06:15 includes SAA orbits
	27-Dec-03	361		DYN001 1X1	¥	8	OFF	OPEN	OFF	-30	-						-28	-						45	01:00:00 / -28 / +45	Cam 3 ANNEAL; Norm TC; Delcers to -30 1-28 / +45
077F7A68	27-Dec-03	361	11:02	DYN001 1X1	1X1	S	OFF	OPEN	OFF		-						-28	-						45	00:13:13 Soft reset	Soft reset
07803444	28-Dec-03	362		DYN001 1X1 ON	×	ő		OPEN	OFF	-30	-						45	-						45	01:00:00	01:00:00 +45 / +45; Soft reset
078008E8	28-Dec-03	362	11:02	DYN001 1X1	1X1	NO NO	OFF	OPEN	OFF	-30	-						45	-						45	00:13:13 Soft reset	Soft reset
078185C4	29-Dec-03	363	Г	-	L	L	L			99	-		Γ				-27	DYN000	1X1	OFF (	OFF	OFF CLOSED	OFF	-3	00:03:30 F	00:03:30 Fast TC; Delcers to -30 / -27 / -3
0781B6FC	29-Dec-03	363	3:45	-	L					-30	DYN000	1	OFF	OFF OFF CLOSED	COSED	OFF	-27	1				S. Carrier		-3	00:01:45	
0781CF98	29-Dec-03	363	5:30	4	4X4	NO.	NO	OPEN	OFF	-50	4	4X4	4X4 ON ON		OPEN	OFF	-50	DYN002	2x2	NO	OFF	OPEN	OFF	-20	01:17:15 L	01:17:15 Delcers to -50 / -50 / -50
078413AC	30-Dec-03	364	22:45	DYN000 1X1 OFF	1X1	OFF		OFF CLOSED OFF	OFF	-50	-			H			-20	1						$\overline{}$	00:01:02	
Г	30-Dec-03		23:47	DYN000 1X1 OFF	1X1	OFF		OFF CLOSED	OFF	-50	-						-50	1							00:00:43	
Г	31-Dec-03		0:30	-						-50	DYN000	1X1	OFF	OFF C	OFF OFF CLOSED OFF		-50	,							00:01:45	
Г	31-Dec-03	365	2:15	-						-50	-						-50	DYN000 1X1	1	OFF	OFF	OFF OFF CLOSED OFF	OFF	-	00:01:45	
07845D80	31-Dec-03	365	4:00	4	4X4	Ö	8	OPEN	OFF	100	4	4X4	4X4 ON ON		OPEN	OFF	-50	-50 DYN002 2x2 ON OFF	2x2	NO O		OPEN	OFF	-50	#REF!	
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Weekly Calibration	alibration						=		DY	DYN000		ever	every week	×				floating temps	tem	SC					•	J. Tappin
2-day End	2-day Engineering Mode Observation	ode Obser	vation				=		DYN	DYN001		ever	y2m	onths	every 2 months (first year)	ear)	-	DOM Of	ni no	FOV,	floati	no moon in FOV, floating temps	SQ		•	<ul> <li>A. Buffington</li> </ul>
High Flat	High Elat Field Calibration	ation					7		13			ever	v 4 m	every 4 months			-	floating temps	temi	SC		,			•	A. Buffington

## SMEI Camera Configuration Log: 2004

Notes:

Times are for beginning of pass in which event occurred, exact time of execution may be up to 15 mins later.

Blue fort denotes polamed activities.

Red fort denotes problems & anomalies.

Green fort denotes WindSar activity.

Magenta fort denotes Spacecraft anomaly.

Orange fort denotes CCD annealing.

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		Comments						Rice / Parity Error Anomaly	DHU Reset		Delcers to -50 / -50 / -03	HOT ANNEAL; norm TC	Fast TC, Delcers to -50 / -50 / -50		Delcers to -50 / -50 / -3; includes SAA orbits	Delcers to -50 / -50 / -50					Invalid Telemetry Anomaly	DHU Reset		includes SAA orbits	soft reset		20 des Van Toet (Toursde the Cart)	+20 deg taw lest (Towalds the Sull)	Pwrd off Cam 3 to avoid overheating	end +20 deg Yaw Test	Cam 3 pwrd on -20 denYaw Test (Away from Sun)	00:19:01	04:22:35 end -20 deg Yaw Test, Delcers to -50 / -50	cease auto-resets	includes SAA orbits			includes SAA orbits; cease auto-resets		includes SAA orbits			cease auto-resets	includes SAA orbits		
		Obs Duration (DD:HH:M	00:01:17	00:00:28	00:01:45	00:01:45	06:19:45	06:21:15	05:05:19	00:01:45	00:01:45	01:00:00	$\overline{}$	00:01:45		_	00:01:45	00:01:45	00:01:45	02:22:23	00:18:19	02:18:33	00:01:45		$\neg$	00:01:45	03:10:43	00:03:41			00:10:24	100.00	04:22:35	00:03:30	00:07:45	00:03:30	00:03:30	$\overline{}$	00:01:45	$\overline{}$	00:01:45	00:01:45			00:01:45	00:01:45
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		Time (Zulu)	22:30	23:47	0:15	2:00	3:45	4:00	21:41	23:30	1:15	3:00	3:00	10:30	12:15	14:00	0:00	1:45	3:30	5:15	3:38	21:57	16:30	18:15	23:47	0:15	2:00	12:43	16:24	3:48	11:00	42.12	23.55	22:30	2:00	9:45	13:15	16:45	3:15	5:00	12:45	14:30	16:15	18:00	1:15	3.00
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		Date	7-Jan-04	7-Jan-04	8-Jan-04	8-Jan-04	8-Jan-04	8-Jan-04	9-Jan-04	14-Jan-04	15-Jan-04	15-Jan-04	16-Jan-04	16-Jan-04	16-Jan-04	16-Jan-04	17-Jan-04	17-Jan-04	17-Jan-04	17-Jan-04	20-Jan-04	20-Jan-04	23-Jan-04	23-Jan-04	23-Jar	24-Jan-04	24-Jan-04	27-Jan-04	27-Jan-04	29-Jan-04	29-Jan-04	29-Jan-04	30-Jan-04	4-Feb-04	5-Feb-04	5-Feb-04	5-Feb-04	5-Feb-04	6-Feb-04	6-Feb-04	6-Feb-04	6-Feb-04	6-Feb-04	6-Feb-04	7-Feb-04	7 Eah OA
		Rev # or UTC (hex)	078E9C28	078EAE34	078EB4C4	078ECD60	078EESFC	078EE980	Rev 5225.1	0797E4B8	0797FD64	079815F0	07996770	0799D0E8	0799E964	079A0220	079ASEC0	079AA75C	079ABFF8	079AD894	079EB656	Rev 5381.1	07A35FC8	07A37864	07A3C634	07A3CCC4	07A3E560	Rev 5474.9	Rav 5477.1	Rev 5498.0	07AB8DB0	Rev 5508.4	Rev 5520.2	07838628	07838760	0784245C	07B45594	07B486CC	07B51A74	07853310	07B5A00C	07B5B8A8	07B5D144	07856960	07B64FD4	OTBREETO

resume auto-resets				Delcers to -50 / -50 / 0; stop auto-resets	Delcers to -50 / -50 / -50; stop auto-resets		Delcers to -50 / -30 / -03		CAM 3 HOT ANNEAL, norm TC; stop auto-resets	Fast TC, Delcers to -50 / -50 / -50, SAA orbits; stop auto-resets		Delcers to -50 / -50 / -3		-50; stop a	DM's pointing study. Delicers to -37 / -50 / -50, stop auto-resets	DM/s pointing study. Delcers to -20 / -50 / -50; stop auto-resets	Delcers to -50 / -50 / -50; resume auto-resets	Leap Day SC Anomaly: SC loss of attitude, eventual transition to Bdot, WindSat despun, SMEI uneffected	SC returned to Reference Pt (normal attitude)				Smerr 2 mans Anomalu 2nd	District Apparent of the Control of		no images due to anomaly	1	DHU Reset - Cam 3 Image Anomaly, 2nd			Anomaly: All-Camera Image problem				DHU Reset All-Camera image anomaly								DHU Anomaly Anomaly resolved by auto-reset					Stop auto-resets	Frame Count Anomaly, little to no images	includes SAA orbits	-1 1
06:11:30	00:01:45	00:01:45	05:13:15	02:00:00	00:04:00	00:01:45	01:00:00		01:00:00	00:08:45	00:01:45	00:01:45	00:03:30	02:00:00	01:00:00	01:00:00	00:06:15	02:21:30	04:02:30	00:01:45	00:01:45	00:01:45	04:03:55	02.10.33	00.01.45	00.01.45	01:12:15	01:06:30	00:01:45	02:09:37	01:12:38	00:01:45	00.01.45	01:13:45	01:05:00	00:01:45	00:01:45	07:18:45	00:01:45	00:01:45	00:01:45	06:04:40	00.01.05	00.01.45	00:01:45	00:01:45	06:11:15	00.00.20	00:01:25	00:07:15	00:01:45
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	fast TC, Delcers to -50 / -50 / -50; SAA orbits		Delcers to -50 / -27 / -3		Delcers to -30 / -25 / -8			Delcers to -50 / -50 / -50, resume auto-resets											Comments of the Comments of th	Soft-reset tur	Cx_FRM_EOF's stop incrementing; bogus temps,	voltages, etc.	SMEI pwr d down via SMEI-U3	S/C ACS anomaly, SV to Safe Hold, ACS to 8- dot, WindSat despun>smilar to 14 Jul 03 anomaly	S/C recovery, returned to Ref Pt ACS mode	DHU pwr'd O	DHU pwr ON, cor	-	Fast TC, Delcers to -50 / -50 / -50			SELL ohing down SME	DHU reset (Code Ver. 3)	C3_FRM_EOF stops incrementing at soft-reset	2	C2 FRM EOF stops incrementing	C3 FRM FOF sto	C1_FRM_EOF stops incremen	C2_FRM_EOF stops incrementing	_	DHU reset, part 2				All frame counters stop incrementing.	DHU reset (Code Ver. 5)			norm TC	C3 HOT ANNEAL - 100% (reached 78.5deqC);	Delcers to -50 / -50 / -50
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		auto-reset					ACS anomaly - SC transitioned to Bdot	executed due to SC anon	SC returned to Reference Pt (normal attitude)			Delcers to -50 / -50 / -50	Image Anomaly. Camera EOF frames stopped incrementing	DHU reset, part 1: SMEI-05, -25 executed (Code	Ver: 5)	DHU reset, part 2: SMEI-24 executed				-	repeat of attempted observation from 15 Oct			-	includes SAA orbite	200000000000000000000000000000000000000	Image Anomaly. Camera EOF frames stopped	incrementing	DHU Reset (Code Ver. 6)	Anomaly:	pre-anneal cal	SOLL STATES	ulderent less les sesses desse	post-anneal cal / weekly cal			DHU Reset, Frozen Analog Monitor Anomaly (Code Ver. 7)	-	-								Anomaly: uncommanded CONFIG mode during soft reset	DHU reset, Uncommanded CONFIG mode		DHU reset, C3 buffer full anomaly				
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SMEI Camera Configuration Log: 2005

Notes:

Times are for beginning of pass in which event occurred, exact time of execution may be up to 15 mins later.

Blue fortif denotes planned activities.

Red forti denotes problems, & anomalies.

Green font denotes WindSat activity.

Magenta font denotes a Spacecraft anomaly.

Orange font denotes CCD annealing.

		Comments																	anomaly - SC transitioned to Bdot	SC returned to Reference Pt (normal attitude)	Camera 1 heater anomaly (deicer stuck on)	DHU reset C1 heater anomaly (Memodram 299)	start C3 anniversary obs (interminted)	(nadausani) on (manana)		Commanding file error - SMEI to CONFIG mode	normal obs resumed	C1 Anniversaroy obs						complete C3 anniversary obs		C2 Anniversary obs						C2 one-day engineering	Consequencias and account	ine-day englistening			
	ŀ	Obs Duration (DD:HH:M M)	00:01:45	00:01:45	00:01:45	06:18:45	00:01:45	00:01:45	00:01:45	06:18:45	00:01:45	00:01:45	00:01:45	06:18:45	00:01:45	00:01:45	00:01:45	01:04:33	00:15:03 IMU	04:10:09 SC n	_	00-06-38 DHU			00:02:00	_	00:03:00 norm		00:01:45	00:00:00	00:01:45	00:01:45	01:20:30	_	00:01:45	00:00:13	-	00:01:45	00.01.45	00.01.45	00:08:15	-		_	00:01:45	00:01:45	00:18:45
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		Date	5-Jan-05	5-Jan-05	5-Jan-05	5-Jan-05	12-Jan-05	12-Jan-05	12-Jan-05	12-Jan-05	19-Jan-05	19-Jan-05	19-Jan-05	19-Jan-05	26-Jan-05	26-Jan-05	26-Jan-05	26-Jan-05	27-Jan-05	28-Jan-05	1-Feb-05	4 Eah OF	20000	2-Feb-05	2-Eah-05	2-Feb-05	2-Feb-05	3-Feb-05	3-Feb-05	3-Feb-05	3-Feb-05	3-Feb-05	3-Feb-05	5-Feb-05	5-Feb-05	5-rep-05	CO-CO-LO	6-rep-05	6 Eah of	S Cob 06	S Eah Of	7 504 05	CO-CO-L-V	8-rep-05	9-rep-05	S-rep-03	9-Feb-05
		Rev # or UTC (hex)	096D41C0	096DSASC	096D72F8	096D8B94	09767C40	097694DC	0976AD78	0976C614	097FB6C0								T	t	T		03310510	09922800	$^{+}$	08827384 0882D804	09835310	09937D40		H		09944220	099454BC	0996CC84		OBOSTOBC	+	+	$^{\dagger}$	UBSB1E04	OSSB36AD	or month	09890340	09941400	099B6640	$^{\dagger}$	09988014

C1 one-day engineering		WINDSAT BAPTA anomaly - CORIOLIS => B-dot				C3 HOT ANNEAL - 100%, norm TC (12 hrs)		post-anneal cal						patch34 & new command uploads					switch to DYN009 mode via tasking file	-	reset via SMEI-06 (test)							switch to DYNU11 modee via tasking file	SWICH TO DATIVOTO TROUGH VIS LABARING THE								ANOMALY: railed auto-reset - SMEI left in BOO! mode	DHU reset, SMEI-06	ANOMALY: C3 Shutter Closed (Not). Started ~24 hrs earlier	DHU reset, SMEI-06	weekly + pre-anneal cals		Co LICT ANNIE AL - 100%, norm TC (12 hre)	C3 HOT ANNEAL - 100%, norm 10 (12 ms)	cool-down - 6 3/4 hrs nost-anneal cal - 4 non-SAA orbits	C3 one-day engineering	normal mode for solar eclipse	C2 one-day engineering	C1 one-day engineering					
01:00:00	02:01:08	00:16:05	01:06:47	00:01:45	00:01:45	00:12:00	00:10:15	00:01:45	06:18:45	00:01:45	00:01:45	00:01:45	01:10:35	00:01:40	05:06:30	00:01:45	24.10.00	00:01:45	01-20-16	00.00.00	04:03:39	00:01:45	00:01:45	00:01:45	06:18:45	00:01:45	00:01:45	00:01:45	06:18:45	00:01:45	00.01.45	06:18:45	00:01:45	00:01:45	00:01:45	00:18:30	00:05:59	05:18:16	01:10:58	01:11:17	00:01:45	00:01:45	00:01:45	00:21:00	00:06:45	01:00:00	01:17:00	01:00:00	01:00:00	01:00:00	00:01:45	00:01:45	06:18:45	00:01:45
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			ANOMALY: Frozen frame counter DHU reset, SMEI-06	WINDSAT spinup anomaly - CORIOLIS => B-dot	Recovery completed: SMEI begins (interrupted) weekly cal via stored commanding file			CORIOLIS commanded to Sun-Point mode	ANOMALY: Cameras "Off"	DHU reset, SMEI-06, memogram 316			weekly + pre-anneal cals		C1&C2 HOT ANNEAL - 100%, norm TC (12 hrs)	cool-down - 4 1/4 hrs	post-anneal cal, C1 & C2											Partition redumps stopped, memogram 319	C3 anomaly onset (approx), memogram 320				DHU reset, SMEI-06, memogram 320				weekly + pre-anneal cals	+			cool-down - 6 3/4 hrs	(approx) CORIOLIS returned to Ref-Point mode		resume normal mode obs	camera anomaly ons	UNO resel, ower-up, memogram	weekly cals			camera anomaly onset (approx), memo 330
00:01:45	00:01:45	04:14:52	00:02:08	00:03:20	00:01:05	00:01:45	04:18:05		00:03:09	02:13:31		00:10:30	00:01:45	00:01:45	00:12:00	00:04:15	00:01:45	00:01:45	02:20:30	00:10:30	00:01:10	00:01:45	00:01:45	07:18:45	00:01:45	00:01:45	05.18.45			00:01:45	00:01:45	00:01:45	06:09:29	00:01:45	00:01:45	00:01:45	00:01:45	00:01:45	00:01:45	00:12:00	00:06:45		00:07:00	00:17:00	00:15:21	04.08.39	00:01:45	00:01:45	02:18:30	00:21:24
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03:02:51 DHU reset, SMEI-06, memogram 330	weeny cals				boot mode anomaly onset (approx), memo 331	weekly cal (nartial - anomaly internint)		C1 one-day engineering	C2 one-day engineering	weekly cals				C3 one-day engineering	resume normal mode	auto-reset anomaly onset, memo 332	DHU reset, SMEI-06, memogram 332	camera image anomaly onset, memo 333	DHU reset, SMEI-06, memogram 333	weekly cals					DHU reset, SMEI-06, memogram 335	weekly cals			alon allower	weekly cals			weekly cals				weekly cals			camera parity anomaly onset, memo 337		weekly + pre-anneal cals			C2 & C3 HOT ANNEAL - 100%, norm TC (6 hrs)	C1 & C3 HOT ANNEAL - 100%, norm TC (6 hrs)	C2 post-anneal cal	cool-down (C1 & C3) + SAA avoidance C1 post-anneal cal	C3 post-anneal cal		weekly cals			Anomaly, memogram 341.
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SMEI Camera Configuration Log: 2006

Notes:

Times are for beginning of pass in which event occurred, exact time of execution may be up to 15 mins later.

Blue fort denotes planned activities.

Red fort denotes problems & anomalies.

Green four denotes WindSat activity.

Magenta fort denotes Spacecraft anomaly.

Orange fort denotes CCD annealing.

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	Comments	C2 one-day engineering	resume normal mode obs	y cal			resume normal mode obs	y cal			resume normal mode obs	PatchUpload (Config&PatchModes patches 1-8)		Patch Upload (patches 9-17)		Patch Upload (patches 18-26)		Patch Upload (ConfigMode, patches 27-32) resume normal mode obs	veal			resume normal mode obs	WindSat B-Dot Mode. Memogram 385	DYN013 24hr Mask Test	10000	y cal		C3 HOT ANNEAL - 100%.	aly, Memogram 392	DYN013 Single-Orbit MaskTest	aly, Memogram 387	Reset	aly, Memogram 388	DYN012 24hr MaskTest-interrupted: bad ROI	Onoils IMU Anomaly HU Reset	C1 anniversary obs					resume normal mode obs	00
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	00:01:45 weekly & pre-anneal cal	01:00:15 Reinstated Auto Resets Memo 426	00:01:20 DHU Reset via SMEI-06B Memo 427	05:18:45 resume normal mode obs			weekly cal	anniversary cals	anniversary cals	anniversary cals	anniversary cals	00:00:00 anniversary cals	00:08:15 anniversary cals	universary cals	00:07:00 anniversary cals	anniversary cals	anniversary cals	00:08:15 anniversary cals	00:01:45 anniversary cals	00:01:45 anniversary cals	00:07:00 anniversary cals	00:03:30 anniversary cals	01:09:33 return to normal oos	Code Upload - ver 35 Memo 489 cont	00:00:44   Code Upload - ver 35 Memo 489	03:21:50 DHU-B reset via SMEI-06B- Memo 423	Frame Increment Anomaly	Old Normal Obs (pre-V35)- Delcers to -50/-50/-50- Memo418	Enabled power to C1, C2- Delcers to +30/+30/+30/ Memo417	08:15:46 C3 shutter-SafeMode-Memo414	07:08:33 1553B; 1553 Wrap Test- Memo412	PDUB- Memo410  Failed Redlined SMFL01 to PWRON DHUA via	Failed Redlined SMEI-01 to PWRON DHUA via	00:01:49 PDUA- Memo407 00:03:34 Esiled Continuation of Memo407- Memo408	Failed Redlined SMEI-01 to PWRON DHUA via	00:08:23   Failed DHU reset- drop in A-side current	00:03:41 No telemetry- no updated C2 images	00:00:05 SMEI soft reset	Anomaly following SAA passage	resume normal mode obs		weekly cal	resume normal mode obs	C3 post-anneal cal	C1 post-anneal cal	C1 & C3 HOT ANNEAL - 100%, 12hrs		00:01:45 weekly + pre-drined cars	resume normal mode obs	00:01:45 00:01:45

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0000	3 and anneal - 100%, norm 10 (1	cs post-anneal cal resume normal mode obs	C3 one-day engineering	C2 one-day engineering	П	resume normal mode obs- C3 in wrong DYNCONF (tasking file error)		weekly cal			resume normal mode obs- DYN014 tasking error Memo 428	resume normal mode obs- DYN010 Memo	nomaly. Frames Slow to locrement	DHU Reset via SMEI-06B Memo 429	Anomaly- Invalid Images	DHU Reset via SMEI-06B Memo 430	weekly cal			resume normal mode obs	Data Redump (Indicies 5 & 6) Due to Poor SMEI Data Memo 434	Anomaly- All Cameras Off	DHU Reset via SMEI-06B Memo 435	weekly cal			resume normal mode obs	nomaly-VCID5 Errors	UHU Reset via SMET-USB Memo 438	weekly cal		resume normal mode obs	knomaly: Boot Mode	DHU Reset via SMEI-06B Memo 439	weekly cal		resume normal mode obs	Anomaly- Stuck in CONFIG Mode	DHU Reset via SMEI-06B Memo 440	weekly cal		resume normal mode obs	OOLs updated Memo 441	weekly cal			resume normal mode obs	knomaly- Invalid Telemetry	DHU Reset via SMEI-06B Memo	weekly cal		resume normal mode obs	C1 one-day engineering	C3 one-day engineering
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Enable patch unpack cmd, part 1 Memo 473	Enable patch unpack cmd, part 2	Mask upload COMPLETE:	nomaly, synch errors	DYN014 implemented in auto-resets	10 reset via new; SME1-076 memo 460	weekly cal		collect mask data	sume normal mode obs	resource mode one	C1 one-day engineering	C3 one-day engineering	C2 one-day engineering	resume normal mode obs	weekly cal	and farmer		resume normal mode obs	BOOT Mode	DHU reset via SMEI-078 Memo 483	weekly & pre-appeal cal			3 HOT ANNEAL - 100%, norm TC (12 hrs)	end of anneal	C3 post-anneal cal		and Anomaly BABTA sin non debne	Corrolls Ref Point	STORE ACT TORIN	weekly cal			resume normal mode obs	weekly cal			resume normal mode obs	weekly cal			resume normal mode obs	nomaly. Abnormal BOS Activity	weekly cal- interrupted			resume normal mode obs	DHU reset via SMEI-07B Memo 488	weekly cal repeated			resume normal mode obs	weekly cal			esume normal mode obs	weekly cal			resume normal mode obs	C1 one-day engineering C3 one-day engineering	Mindel anguianing
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oz one-day engineering	oost cal		and another more over	Weekly (resames) csl			OT ANNEAL - 100%, norm TC (12 hrs)	post anneal cal (C2 not cooled enough)		resume normal mode obs	C BOOT Mode	DHU reset via SMEI-07B Memo 490	iai			resume normal mode obs	Patch Upload (Config&PatchModes: patches 1-9) *Left in Patch Mode	Patch Upload (Patch Mode: patches 10-19)	resume normal mode obs	Patch Upload (Config&PatchModes: patches 20- 26)	resume normal mode obs	Patch Upload (Config&PatchModes: patches 26- 32) *Left in Patch due to short contact	resume normal mode obs via auto reset	DYN013 10 Minute Mask Test	02:23:50 resume normal mode obs	le:		00:01:45	900 000	la la la la la la la la la la la la la l		resume normal mode obs	r BOOT Mode	DHU reset via SMEI-07B Memo 493	al			resume normal mode obs	Primary Data Analyst J. Tappin A. Buffington
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SMEI Camera Configuration Log: 2007

7/18/2008

Notes:

Times are for beginning of pass in which event occurred; exact time of execution may be up to 15 mins later. Blue fort denotes planned activities.

Red fourt denotes problems & anomalies.

Green fort denotes WindSat activity.

Magenta fort denotes a Spacecraft anomaly.

Orange fort denotes CCD annealing.

	Comments	weekly cal		resume normal mode obs	weekly cal			resume normal mode obs	Anomaly: Frame Incrementing Errors	DHU reset via SMEI-07B Memo 494	weekly cal		the state of the s	resume normal mode obs	C1 anniversary obs				resume normal mode obs	C3 appiversary obs					resume normal mode obs	C2 anniversary obs				resume normal mode obs	weekly + pre-anneal cals			C1 & C3 HOT ANNEAL - 100%, 12hrs	Anomaly: Frame Errors, anneal continued	DHU reset via SMEI-U/B Memo 495	C1 post-anneal cal	resume normal mode obs	weekly cal			resume normal mode obs	weekly cal		resume normal mode obs	weekly cal			resume normal mode obs	weekly cal
	Obs Duration (DD:HH:M	00:01:45 v	00:01:45	06:18:45			00:01:45	02:03:45 г		04:06:14		00:01:45		-	_	00:01:40	20.00	00.01.45	_			00:00:00	00:01:45	_			00:01:45	00:07:00	00.00	-	-	-	00:01:45	00:00:15			00-01-45				00:01:45		$\overline{}$	00:01:45	00:01:45				06:18:45	00:01:45 weekly cal
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7/18/2008

200 STREET, 100 ST	Comments			resume normal mode obs	Anomaly: Dropped Frames	Und reservita Smell-of a Memo 497	peny ca		resume normal mode obs	weekly cal			resume normal mode obs	Anomaly: Command Reject	TO reset via SMEI-U/B Memo 498	weekly cal			ume normai mode obs	1 one-day engineering (23 minute data gap)	C3 one-day engineering	C2 one-day engineering	pre-anneal cal			3 HOT ANNEAL - 100%, 12hrs	nomaly: Dropped Frames	DHU reset via SMEI-07B Memo 499	C3 post-anneal cal	sume normal mode obs	weekly cal		resume normal mode obs	nomaly: SMEI Sustems Off	DHU reset via SMEI-07B Memo 502	oriolis Anomaly IMU Upset	Coriolis Ref Point	weekly cal		contract manner list also also	Some normal mode dos	Patch Mode	Patch Upload (Patch Mode: patches 8-20) *Left in Patch Mode	Patch Upload (PatchMode: patches 21-32)	sume normal mode obs	(Faise) Anomaly: Small Files DHU reset via SMEL078 Memo 510	and the second s	COUNTY COL		DYN013 10 Minute Mask Test	resume normal mode obs	nomaly: SMEI Systems Off	DHU reset via siMEI-07B Memo 511	weekly cal		resume normal mode obs	Anomaly: Data Loss	HU reset via SMEI-U/B Memo 512	sekly cal
	Obs Duration (DD:HH:M	1000	00:01:45	04:03:12 re		01:03:47		00:01:45		00:01:45 w	00:01:45	00:01:45				00:01:45 w	00:01:45	00:01:45	03:18:45 re			01:00:00 C	00:01:45 pr	00:01:45	00:01:45	00:18:38 C			_	_		00:01:45			02:00:16 Di		1	_	00:01:45	00:01:45		00:01:01 Pe	00:02:10 MA	00:00:00	00:00:00	00:05:20		00.01.45	00:01:45		Н	01:12:34 A	00:10:12 U	00:01:45 we	00:01:45	00:18:45 re	00:20:05 A	05:03:55 D	U0:01:45 Jvv
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epared by Jessica Hewitt and Paul Holladay

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	Comments			resume normal mode obs	weekly cal		resume no	pre-anneal cal		C3 HOT ANNEAL - 100%, 12hrs	C3 post-anneal cal	resume normal mode obs	Anomaly Boot mode	Anomaly Bod mode again	Reset via SMEI-07B, Memo 514	weekly cal			C3 one-day engineering	CZ one-day engineering	resume normal mode obs (C3 in DYN010)	weekly cal			resume normal mode obs	weekly cal		resume normal mode obs	ACS anomaly, Coriolis to SAFE mode; SMEI still ON		weekly cal		resume normal mode obs	Coriolis 1553 anomaly—no telemetry from Star Trackers, WindSat, or SME!	Vehicle to	ndSat to use 1553 Bus-B;	auto-resets discontinued	SMEI anomaly, cameras pwr'd OFF (discernable in PLB_B_CUR)	partial DHU reboot via bilevel cmd; DHU returned to "known state".	1750 reset procedure, partial DHU reboot, enabled SMEI RT on the 1553 Bus A.—SMEI telemetryll They got 1553 errors when they enabled the ST and WindSat, so they disabled them.	Switched to 1553 Bus B: SMEI worked, ST worked, rec'g only natrial telem from WindSat	SMEI returned to normal obs mode, veh still in Sun Pt. No sky mans due to lack of qualemion data	Auto-resets resumed	cond'd SAFEHOLD to pwr-down WindSat, uncontrolled spin- down. Coriolis to b-dot, WindSat pwr'd ON, telemetry seriolet SME remained pwr'd ON thru this.	ACS anomalv—IMU upset. WindSat pwr'd OFF.	pre-anneal cal		AND THE THE TOTAL TOPIC	C2&C3 HOT ANNEAL - 100%, TARES
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Prepared by Jessica Hewitt and Paul Holladay

	Comments	C3 post-anneal cal		resume normal mode obs	Vehicle back to Reference Pi	SSR indices re-synched		weekly cal, repeat due to lost data			Fesume hormal obs	Corrols SAFEHOLD:	Coriois IMU anomaly: vehicle to B-dot, then Sun Pt. WindSat	uncontrolled spin-down	5 weekly cal	5	5 data lost due to IMU anomaly	p resume normal obs	S vehicle to Ref Pt		7 resume normal obs		Reset via SMEI-06B; Memo 550	4 Coriols SAFEHOLD; Star Tracker	Coriolis B-Dot Mode		WindSat spin-up	5 weekly cal	2	3 C3 cal interrupted due to Coriolis Star Tracker Anomaly	-	Star Tracker soft reset	C1 one-day engineering		-	3 resume normal obs	Star Tracker threshold changed from 5,5 to 5,75; 9 Safehold Trine in the next 22 hect	-13		resume normal obs mode, but Coriolis still in Sun Pt	Switch from -Roll Star Trikr to +Roll Star Trikr,	set to 5.5; +Roll ST does not produce quaternions, so vehicle stays in Sun Pt.	-	S Presun Pt cycling	despun	Vehicle returned to Sun Pt	5 weekly cal		resume normal obs mode, but Coriolis still in Sun Pt		after power cycle.	Coriolis -5 deg Roll offset	Corills return	repeat weekly cal	0 15	resume normal obs mode	WindSat spin-up to 0.3 RPM to investigate W/S-induced glint		
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	Date	28-Jun-07	28-Jun-07	28-Jun-07	70-UN-97	28 1:10 07	10-III-02	30-Jun-07	30-Jun-07	30-Jun-07	30-Jun-07	30-Jun-07	in-inc-oc	2-Jul-07	5-Jul-07	5-Jul-07	5-Jul-07	5-Jul-07	5-Jul-07	7-Jul-07	70-lul-7	8-Jul-07	8-Jul-07	20-Jul-6	9-Jul-07	9-Jul-07	9-Jul-07	11-Jul-07	11-Jul-07	11-Jul-07	11-Jul-07	12-Jul-07	13-Jul-07	14-Jul-07	15-Jul-07	16-Jul-07	47 1.4 07	1/-Ini-0/	18-Jul-07	18-Jul-07		18-Jul-07		20-Jul-07	24-Jul-07	24-Jul-07	25-Jul-07	/0-Inr-67	25-Jul-07		25-Jul-07	27-Jul-07	27-Jul-07	28-Jul-07	70-In-87	28-Jul-07		30-Jul-07	
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	-	Comments	Anomalous SOH telem: all T, I, V's static; frame counters & images good.		weekly cal		resume normal obs mode	weekly cal		resume normal obs mode	pre-anneal / weekly cal		C1&C3 HOT ANNEAL - 100%, 12hrs	Anomaly. No images			resume normal mode obs DHU Reset via SMEI-06B; Memo 605	Anomaly, corrupted images	DHU Reset via SMEI-06B; Memo 606			weekly cal		resume normal obs mode	Anomaly: BOOT mode	weekly cal>no data	>no data		DHU reset via SMEI-06B; I	weekly cal - repeat		resume normal obs mode				DYN013 10-min Mask Test		auto-reset updated to implement C3 DYN014	Coriolis ACS anomaly, SV to B-dot, WindSat despun; IMU	SV have a deal of the second	Weekly cal			resume normal obs mode	Conolis ACS anomary, SV to b-dot, IMU initiated during SA transit	SV back to Ref Pt.	Anomaly: skymap striation in C1, C2	weekly cal		resume normal obs mode	DHU reset via SMEI-07B, Memo 629	weekly cal	
	Obs Duration (DD HH M	(W)	02:12:14	01:07:46	00:01:45	00:01:45	06:18:45	00:01:45	00.00	06:18:45	00:01:45	00:01:45	00.01.45	00:01:06	00:05:15	00:01:45	00:17:15	00:09:35	02:16:55	00:09:55	01:03:25	00.01.45	00:01:45	06:18:30	00:00:15	00:01:45	00:01:45	00:00:14	01:18:31	00:01:45	00:01:45	04.18.45	00:01:45	00:01:45	00:01:45	00:00:10	00:12:45	05:09:24	00.00	00.09.35	00:01:45	00:01:45	00:01:45	00:02:01	00:12:59	05:09:45	00:18:00	00:01:45	00:01:45	00:14:55	06:03:50	00:01:45	00:01:45
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	Time	(Zulu)	4:00	16:14	0.00	3.30	5:15	0.00	06.6	5.15	00:00	1:45	3:30	22:54	00:00	5:15	14:55	8:10	17:45	10:40	20:35	0.00	3.30	5:15	23:45	000	3-30	5.15	5:29	00:00	1:45	3.30	00.0	1:45	3:30	5:15	11.00	23:45	3	9.09	0.00	1:45	3:30	5:15	7:16	20:15	9:00	00:00	1:45	5-15	20:10	00:00	3:30
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		Date	4-Aug-07	6-Aug-07	8-Aug-07	8-Aug-07	8-Aug-07	15-Aug-07	15-Aug-07	15-Aug-07	22-Aug-07	22-Aug-07	22-Aug-07	22-Aug-07	23-Aug-07	23-Aug-07	23-Aug-07	24-Aug-07	24-Aug-07	27-Aug-07	27-Aug-07	29-Aug-07	29-Aug-07	29-Aug-07	4-Sep-07	5-Sep-07	5-Sep-0/	5-Sep-07	5-Sep-07	7-Sep-07	7-Sep-07	7-Sep-07	12-Sep-07	12-Sep-07	12-Sep-07	12-Sep-07	12-Sep-07	12-Sep-07		18-Sep-07	19-Sep-07	19-Sep-07	19-Sep-07	19-Sep-07	19-Sep-07	19-Sep-07	25-Sep-07	26-Sep-07	26-Sep-07	26-Sep-07	26-Sep-07	3-Oct-07	3-Oct-07
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Prepared by Jessica Hewitt and Paul Holladay

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Control of the Calmin of Calmin of the Calmi	Comments	resume normal obs mode	Anomaly: no valid images	DHU reset via SMEI-07B, Memo 633	pre-anneal / weekly cal			C3 HOT ANNEAL - 100%, 12hrs	anneal ends	C3 post-anneal cal	01:05:45 resume normal obs mode	Anomaly: invalid telemetry	DHU reset via SMEI-07B, Memo 636	weekly cal			06:18:45 resume normal obs mode	weekly cal			resume normal obs mode	Anomaly: inadvertent reset, SMEI in BOOT	00:08:45 DHU reset, mistakenly by SMEI-06B, C3 in DYN010	00:00:15 Auto-reset returns C3 to DYN014	weekly cal		resume normal obs mode	Anomaly: Inadvertent reset, SMEI in BOOT	DHU reset via SMEI-07B, Memo 636	weekly cal			resume normal obs mode		<i>Primary Data Analyst</i> J. Tappin A. Buffington
	Obs Duration (DD:HH:M M)	04:05:09	00:06:16	02:07:20	00:01:45	00:01:45	00:01:45	00:12:00		00:05:15	01:05:45	00:07:25	04:05:35		00:01:45	00:01:45	06:18:45	00:01:45	00:01:45	00:01:45		00:03:00	00:08:45	00:00:15	00:01:45	00:01:45	04:16:05	00:03:40	01:23:00	00:01:45	00:01:45	00:01:45	#VALUE!	31:00:00	
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	Time (Zulu)	5:15	10:24	16:40	00:0	1:45	3:30	5:15	17:15	0:00	5:15	11:00	18:25	00:0	1:45	3:30	5:15	00:00	1:45	3:30	5:15	12:00	15:00	23:45	00:00	1:45	5.15	21.20	1:00	00:0	1:45	3:30	5.15		vation
	9	276	280	280	283	283	283	283	283	284	284	285	285	290	290	290	290	297	297	297	297	303	303	303	304	304	304	308	309	311	311	311	311	-39082	ion ide Obsei
	Date	3-Oct-07	7-Oct-07	7-Oct-07	10-Oct-07	10-Oct-07	10-Oct-07	10-Oct-07	10-Oct-07	11-Oct-07	11-Oct-07	12-Oct-07	12-Oct-07	17-Oct-07	17-Oct-07	17-Oct-07	17-Oct-07	24-Oct-07	24-Oct-07	24-Oct-07	24-Oct-07	30-Oct-07	30-Oct-07	30-Oct-07	31-Oct-07	31-Oct-07	31-Oct-07	4-Nov-07	5-Nov-07	70-voN-7	7-Nov-07	7-Nov-07	7-Nov-07	300	ard Operati libration neering Mo
	Rev # or UTC (hex)	06953914	t	0E981FA0	t		Н		0E9F1C54	06967840	0E9FC514	H	0EA1CFBC	0EA76440	0EA77CDC	0EA79578	0EA7AE14	0EB08EC0	0EB0875C	0EBOCFF8	0EB0E894	0EB83080	П	0E8906BC	0EB9D840	0EB9F1DC	0EBA0A78 0EBA2314	+	+	+	0EC32C5C	0EC344F8	0EC35D94	FF43E4F240	Non-standard Operation Weekly Calibration 2-day Engineering Mode Observation